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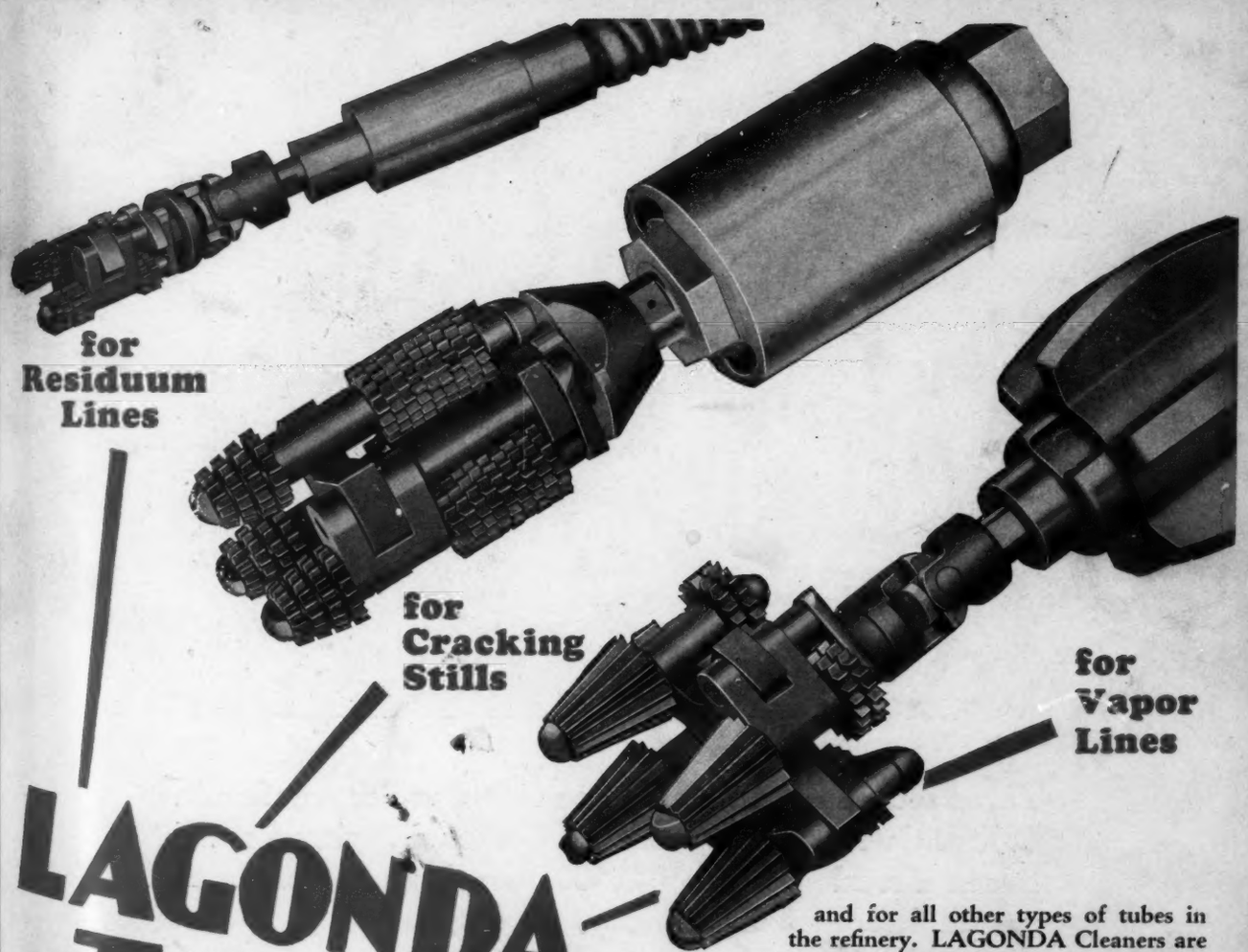

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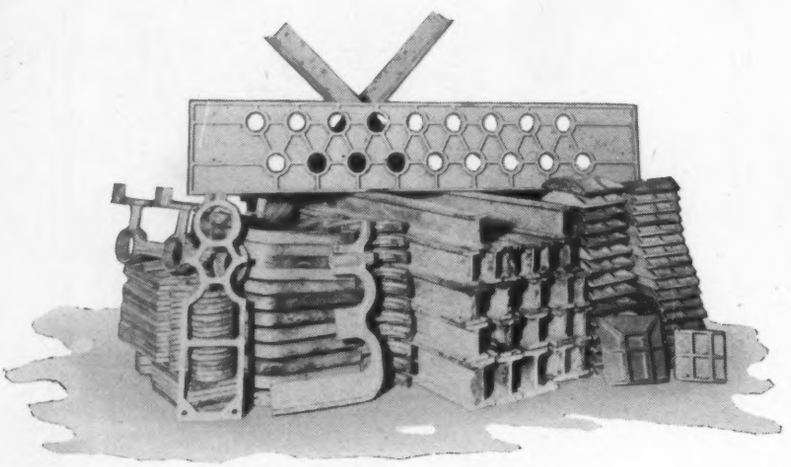

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Vol. 7, No. 11 NOVEMBER, 1928

The REFINER

AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

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Now Hold It

THERE still remains a major effort for the independent refiner in holding a sensible gasoline market. The refining industry made a valuable contribution in adjusting output, to the end that profit-making prices were the result. This effort of the independent refining industry and the efforts of other divisions of the whole petroleum industry brought about the revision of the Quantity Discount Agreement.

This revised selling system is now in its second month. It has brought satisfactory results and indications are for continued sound marketing.

But a warning is not out of place. Profitable marketing is not going to continue unless each division of the petroleum industry continues to be alert. The revised Quantity Discount Agreement is not the end of economic troubles. It is but a change. Benefits will continue just as long as the petroleum industry is determined to have benefits.

The trend of retail prices and marketing practices depends largely on the refiner. Just as he played his part in bringing desirable changes, he can have a part in holding the benefits already won and assuring other desirable changes.

There are two activities the refiners, especially those of the Mid-Continent area, should guard closely. One is the holding of plant output down to current consumption. The other is to prevent gasoline from passing into the hands of jobbers, who decline to adopt sensible and profitable marketing practice. What refiners have done in the past eight months along the line of proper output, lends encouragement for the future.

Avoiding the undesirable jobber is a job for the sales departments of the independent refiners. Sales managers should know where their gasoline is going.

Here is the danger. It seems safe to say that 95 per cent. of gasoline now sold in the Middle West is going through filling station pumps without rebates. Jobbers generally have grabbed greedily that part of the revised Q. D. A. which eliminated service station discounts.

But there are a few jobbers who continue to give discounts. They are convinced they can sell favorite customers at discounts and still maintain good standing.

It is this type of jobber the independent refiners must shun. His volume is not large but the possible damage he can bring is large. If this jobber finds supplies difficult to buy, his discounted sales will decrease. If he can get gasoline without difficulty, his ignorant and unscrupulous selling will grow. There is little need to predict what growth of rebates will finally bring. This sort of selling brought the old Quantity Discount Agreement in 1925.

It is within the realm of good sense to decline to sell gasoline to this class of jobbers. Many refiners have retail outlets. Through these they are selling without service station discounts. The greater number of jobbers buying from refiners, also are selling without rebates. When a refiner puts his gasoline into the tanks of dealers who are giving discounts he is jeopardizing the business of his own service stations and the business of his desirable customers.

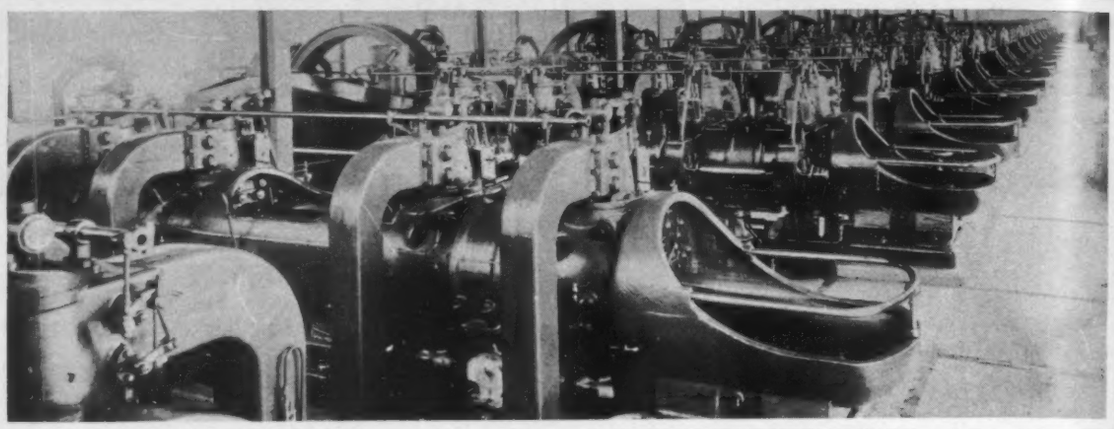
It is legal to decline to sell gasoline to jobbers of this class. A refiner can decline to sell gasoline for any reason or for no expressed reason. No law requires one man or concern to sell merchandise to another man or concern. A transaction is a personal matter.

No mass action is necessary. When a refiner learns that his gasoline is being sold at retail at prices lower than the prevailing market, he should make his own decision and then refuse to ship more gasoline to that jobber. In so doing, he will protect his own profitable business. By as much as all refiners follow such practice, they will protect the whole of profitable business.

Perhaps the time will never come when all gasoline moves at retail at uniform and profit-making prices. But such a portion of it can be forced to bring profit, that the remaining portion will be negligible and will never destroy the profit structure. Each refining concern must hold a section of the battle line in that effort.

Grady Tribbett

95 years



Five years from a century of Engine Building

The first Cooper cupola built by Charles and Elias Cooper in 1833, was the primitive beginning of the present C. & G. Cooper Company. To buy this modest equipment Charles Cooper sold one of his three horses for $50.00.

IN 1833 about the time Jackson began his second term—twelve years before Morse perfected his telegraph and steam was first harnessed to the printing press, the Cooper brothers built their first engine. It was a sweep for converting the power of a horse into a rotary motion for driving a foundry cupola blower.

It is often remarked that the first one hundred years are the hardest. We venture this is wrong. In engine building, at least, we are sure they have been the easiest.

It is much harder today than ever before to maintain the standard of excellence with which Coopers have always been identified. New metallurgical processes, new ideas of engine design, new machine shop tools and manufacturing methods, new power and service problems in the field are all making it increasingly difficult to maintain that standard of excellence. Here at Coopers, research and designing engineers, foundry and machine shop specialists are constantly selecting the good from this maze of new ideas. Experience has taught these men to judge wisely—and is a guarantee that Cooper machinery will continue to represent the very latest advancements and the same standard of excellence.

THE C. & G. COOPER COMPANY

DALLAS, TEXAS MT. VERNON, OHIO LOS ANGELES, CALIF. TULSA, OKLA.

COOPER

Mention Where You Saw the Advertisement

Winter Gasoline Demand Nearing That of Summer

By H. J. STRUTH
Petroleum Economist

THE term "seasonal" now has scant significance to the gasoline market. For the first time in the history of the oil industry the demand for gasoline during the winter months of 1928-29 will very nearly equal the demand experienced during what has up to now been termed the "motoring season." A study of potential gasoline requirements from November 1 until next April reveals that domestic gasoline demand during that period will probably aggregate about 92 per cent. of the demand experienced during the preceding six months of the present year. Although there has been a tendency in this direction during the past few years, there is now, for the first time, a definite indication that the refiner and marketer are assured of a big gasoline demand during every month of the year. We are now entering a period where each month in the year is a billion gallon month. This is another bright spot in the oil situation that warrants an optimistic outlook for the immediate future.

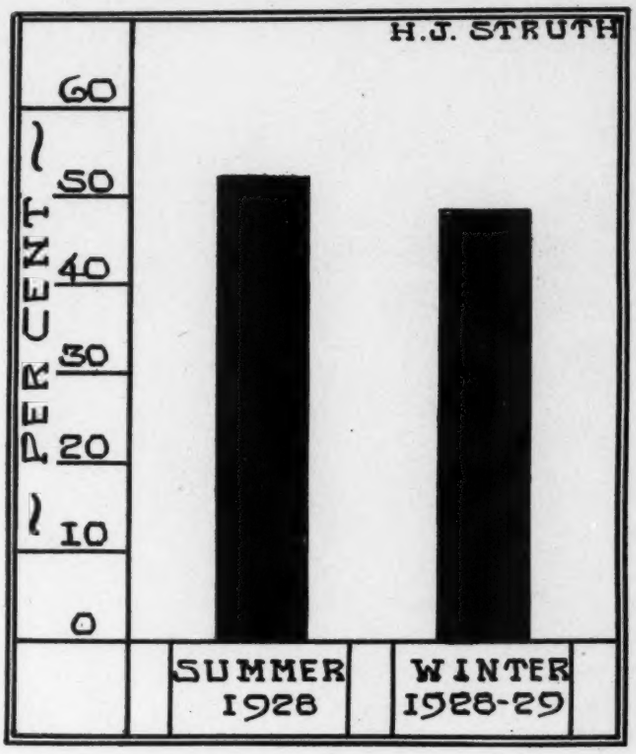


FIGURE 1

Percentage of gasoline sold in summer and winter periods. For the six months ending with May, 1929, demand will represent 48 per cent. of the entire 12-month period, or 92 per cent. of summer demand.

In the accompanying chart, Figure 1, there is presented a striking comparison between what the writer has termed "summer" and "winter" gasoline demand. The summer period includes the six months beginning with May and ending with October, 1928. During this period, gasoline consumption in the United States aggregated 7,612,000,000 gallons. During the next six months, or from November, 1928, to April, 1929, the gasoline required in the United States will aggregate about 7,001,000,000 gallons. At this rate, gasoline consumption during the cold months of the year represents approximately 48 per cent of the total demand for the entire twelve-month period. In this connection, it has been determined by the writer that even during the coldest months of the year, namely, December, January and February, the average consumption of gasoline per motor vehicle registered has increased from 92 gallons per car in 1918-19, to 137 gallons per car in 1928-29. These figures are significant of the trend toward all year motoring, and a consequent "peak" gasoline demand throughout every month in the year. In the accompanying chart, comparatively little difference is noted between the winter and summer gasoline demand; the bar for summer registers 52 per cent., while the bar for winter will probably reach the point indicated, or 48 per cent. Back in 1918-19, a similar chart would have shown the summer demand at 63 per cent. and winter at 37, a decided difference in gallonage.

CLOSED CAR RESPONSIBLE

One of the chief reasons for this remarkable development in the gasoline market is the decided popularity of the closed, all-weather motor car. Each year finds more and more closed cars in operation, with the result that today, the output of closed cars represents 88 per cent. of the production of all types manufactured by the motor car industry of the United States and Canada. The pronounced popularity of the closed car is illustrated in the accompanying chart, Figure 2, which shows the percentage of closed cars produced during the last 11 years. This data was obtained from the National Automobile Chamber of Commerce, for the years 1918 to 1927 inclusive; the percentage for 1928 having been estimated by the writer.

These facts prove conclusively that the former practice of storing gasoline at refineries during the winter months is a thing of the past. From now on, the refiner's production schedule must necessarily contemplate shipping practically as much gasoline during the winter months as he does during the summer period. In other words, there will be no let-up; it will be a case of converting surplus gasoline storage facilities for the accomodation of other seasonal products, such as fuel oil and distillates, thus maintaining only a sufficient gasoline storage to take care of current shipments. The same holds true in the marketing end of the business, but of a reverse order. Instead of converting some of the winter gasoline storage facilities, at bulk stations, to distillates and furnace oils, it may be necessary to build additional storage tanks for the latter, because gasoline storage tanks will be in full use every month of the year.

Another important factor that is exerting a marked influence upon the winter gasoline market is the mo-

tor bus. According to "Bus Transportation" there are now more than 86,000 motor buses in operation in the United States. This means that during the last three years alone the number of buses have increased more than 62 per cent. During the year 1927, the total mileage covered by buses in the United States aggregated more than 13,000,000 miles! The majority of buses now operate on regular schedules throughout the year. This consistent growth in motor buses is now beginning to have marked effect not only upon the winter gasoline demand, but also upon the growing average annual demand per motor vehicle. As a matter of fact, however, the motor bus is only beginning to affect the rate of gasoline consumption per vehicle, the full import of which will not be particularly noticeable for several more years. While the motor bus is the largest individual consumer of gasoline, the aggregate annual consumption by this class of motor vehicles still represents a comparatively small part of the demand by motor cars. It must, however, be conceded that the motor bus is rapidly becoming an important factor in the gasoline market. With the great popularity of the closed motor car and the rapid expansion in motor bus transportation, there is no longer any reason to doubt that America's motoring season comprises every month in the year.

PAVED HIGHWAYS HELPING

Some idea of the marked increase in gasoline consumption per motor vehicle can be gained from the following averages for the four seasons of the year, comparing the years 1919 and 1928. Particular attention is called to the remarkable gain registered during the winter months.

AVERAGE CONSUMPTION OF GASOLINE PER MOTOR VEHICLE
(Gallons)

Spring	1919	1928
March	29	44
April	35	48
May	48	51
Total	112	143

Summer	1919	1928
June	45	54
July	58	58
August	55	61
Total	158	173

Autumn	1919	1928
September	54	57
October	50	53
November	42	51
Total	146	161

Winter	1919-20	1928-29
December	34	50
January	28	43
February	30	44
Total	92	128

A review of the gasoline situation for the past ten years shows a decided trend toward increased gasoline consumption per motor vehicle. The figures given above are a striking example of this trend. When we consider that there are now more than 600,000 miles of surfaced highways in the country, we begin to realize the reason for the increased individual use of gasoline. These good roads also play an important part in making it possible for our closed cars and buses to operate during winter months.

The rapidity with which gasoline demand has been overtaking the supply has resulted in a sharp decline in stocks of gasoline at refineries. Another unfailing sign that we are rapidly emerging from our period of overproducton is our gasoline stock situation. At the peak of the gasoline accumulation period, on March 31, of this year, stocks of gasoline represented the lowest carry-over in the history of the oil business. On that date, gasoline storage represented only 75 gallons per motor vehicle, compared with 96 gallons on March 31, 1927, and similarly high inventories in prior years. On August 31, of this year, the Bureau of Mines report showed that gasoline stocks had declined to 27,197,000 barrels which converted to gallons, represented only 50 gallons per motor vehicle. This is the lowest point recorded in many years, indicating that the lowest point in surplus gasoline stocks will have been recorded during the present year. Any fears that may have been felt over the immediate future of the refining and marketing business are quickly dispelled when this picture is viewed. The accompanying graphic chart, Figure 3, presents one of the most pleasing pictures of the gasoline situation that has been produced for many a year. What could be more pleasing

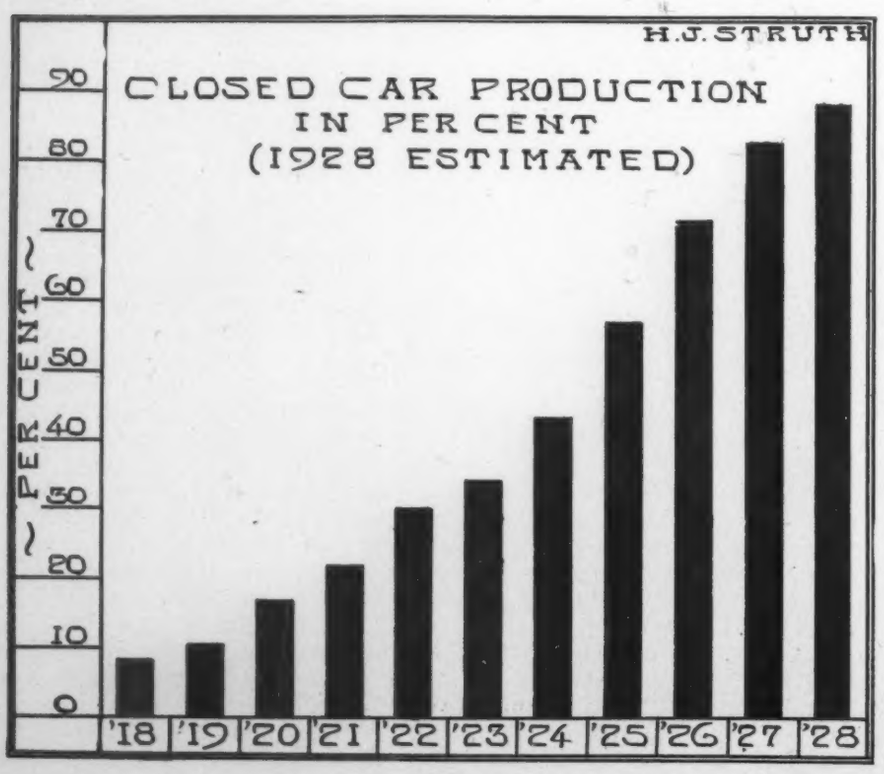


FIGURE 2

than to find stocks at "rock bottom," with demand cutting the production stream directly into consuming channels?

It will be noted on the chart that gasoline consumption per motor vehicle has embarked upon a decided upward trend during the last few years. It will also be noted that the low point reached each year, during the winter period, has been consistently higher each year, with the indication that the 1928-29 winter period will show the highest mark ever recorded. Another point that should be recognized is that the decline from the peak demand month is prescribing a shorter and more gradual curve than formerly. This is being directly influenced by the factors outlined whch are gradually equalizing the former seasonal variation in gasoline demand.

FUTURE GROWTH

Throughout all of the years for which gasoline statistics are available, there has been a steady increase in demand, not only in total, which is naturally influenced by the increase in motor vehicle registration, but also in the average consumption per motor vehicle. A comparison of the gasoline demand for the years 1919 and 1928 presents some startling facts.

Since the average per car is based upon all domestic gasoline consumed, the averages are somewhat higher than the quantity actually consumed exclusively by motor vehicles. In the same manner, stocks of gasoline per motor vehicle includes all gasoline on hand at refineries, although a part of this gasoline is consumed for other purposes. Demand for September to December, 1928, inclusive, has been estimated by the writer. Since motor vehicles are the chief consumers of gasoline, it is apparent from the above data that there is decided trend toward greater annual consumption per motor vehicle.

While the information disclosed herein is most encouraging to both the refiner and marketer, it can be stated with confidence that the future will show even more remarkable results. The use of closed cars will, in all probability, continue to show further gains, no doubt to the point where practically all cars on the road will be of the all-weather type. The motor bus is rapidly becoming an important factor in the field of American transportation, and is destined to reach immense proportions. The number of buses now in operation is only an indicaton of what we can expect in this direction in the near future. Highway systems are gradually being extended, having already reached the point where it is now possible for the motorist to travel from coast to coast over fine surfaced highways. All of these factors indicate that the petroleum industry is now on the threshold of a new era. The fact that gasoline will now be in big demand even during the coldest months of the year, spells an added demand for crude petroleum. Thus, as time goes on, what has been termed overproduction in the petroleum industry will prove to be, under this new era, inadequate to meet the demand. We may be facing a long, cold winter, but this time it spells a record breaking gasoline demand.

GASOLINE DEMAND FOR 1919 AND 1928 COMPARED

	1919		1928	
	Total (Mill. Gals.)	Average per car (Gals.)	Total (Mill. Gals.)	Average per car (Gals.)
January	169	25	878	39
February	186	27	886	39
March	201	29	1,008	44
April	243	35	1,079	48
May	328	48	1,168	51
June	306	45	1,218	54
July	396	58	1,344	58
August	376	55	1,392	61
September	368	54	1,300	57
October	338	50	1,190	53
November	285	42	1,146	51
December	238	34	1,136	50
Total	3,434	502	13,745	605

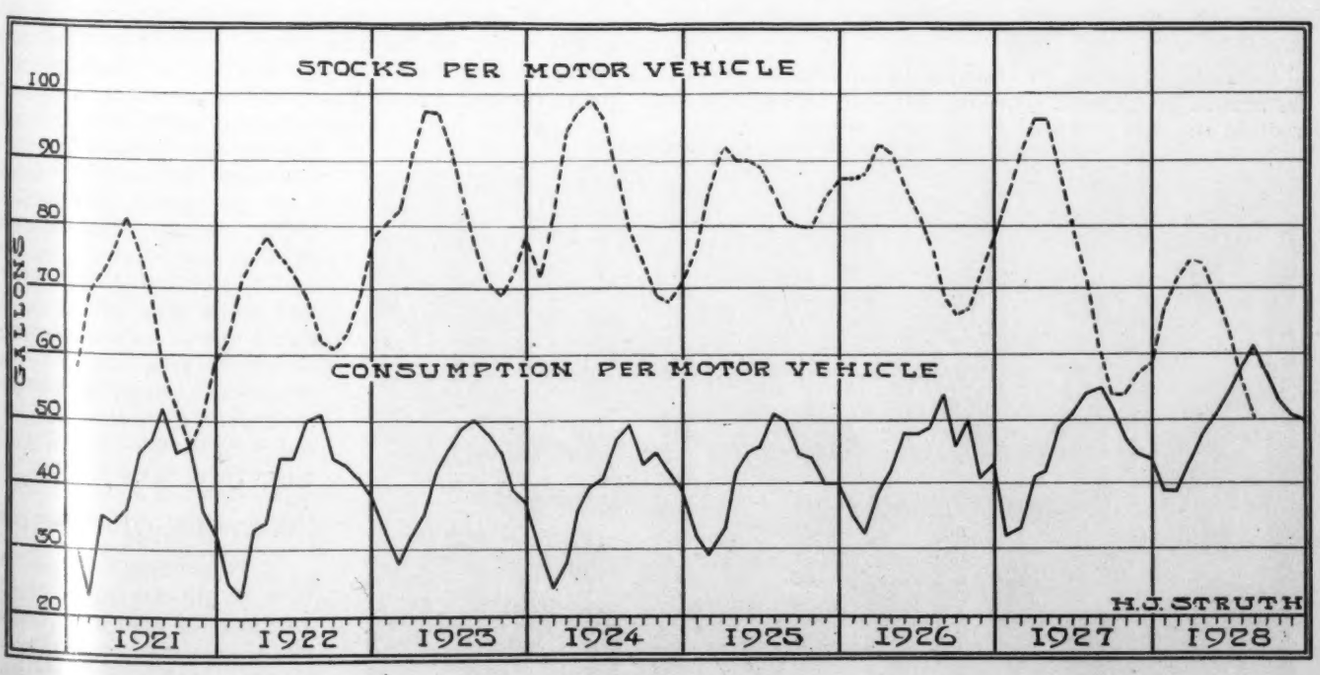


FIGURE 3

Consumption and stocks of gasoline per motor vehicle registered. Note upward trend of winter gasoline demand and marked decline in stocks at refineries.

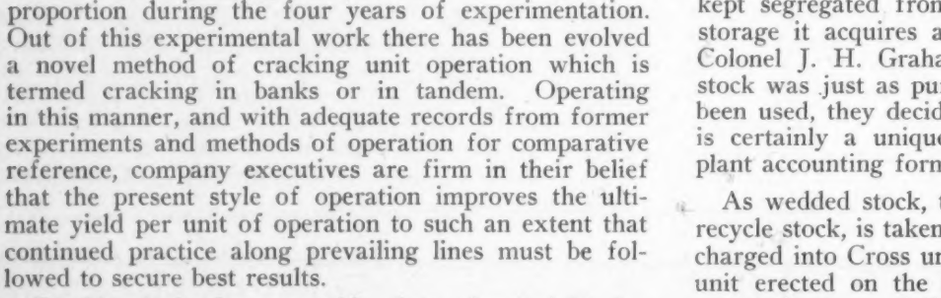
Indian Refining Company Has Singular Operation of Cracking Units

IN 1919-20 the first Cross cracking unit of commercial type designed for continuous operation was erected at the plant of the Indian Refining Company at Lawrenceville, Illinois. In 1923 the company erected its second Cross unit. During 1928 both of these units, operating formerly side by side, were shut down and dismantled, and on the site of the first unit was erected what is possibly the latest unit of this type.

In the intervening years the Indian Refining Company has conducted a great number of experiments in the cracking art. It will be recalled that some of the earliest Flemming units were operated for a long time by this company. Also their installation of four Dubbs cracking units has been in operation for a number of years. The Flemming equipment has been discontinued. At present there are four Dubbs units, six single Cross and one double Cross units in operation. The new unit, termed a double unit because of its two reaction chambers, retains its old numbers, 1 and 2, because of its double chambers and because of the fact that it operates on the site of the two earlier installations.

With this outlay of cracking equipment the company has been enabled to run its cracking plant charging stocks, its various recycle stocks from both Dubbs and Cross units in probably every conceivable manner and proportion during the four years of experimentation. Out of this experimental work there has been evolved a novel method of cracking unit operation which is termed cracking in banks or in tandem. Operating in this manner, and with adequate records from former experiments and methods of operation for comparative reference, company executives are firm in their belief that the present style of operation improves the ultimate yield per unit of operation to such an extent that continued practice along prevailing lines must be followed to secure best results.

Cracking in banks, or cracking in tandem, might also be termed progressive cracking, for with this system no recycle stock is returned to the unit where it is made, but is kept separate throughout the system and cracked again in a second battery of units, and further, recycle stock from these units is taken to the third battery of cracking stills and cracked a third time. In order to clearly present the processes and methods involved in this practice of handling cracking equipment it is best to follow the crude flow through the plant.



General view of Indian Refining Company's cracking department, consisting of four Dubbs and seven Cross units, at Lawrenceville, Illinois.

STOCKS SEGREGATED

Incoming crude oil is first stripped of its gasoline, kerosene, and gas oil in Cross tube stills, thus preparing finished gasoline, kerosene distillate for redistillation, gas oil for charging stock to the cracking plant, and topped crude which is taken to the company's new lubricating oil process plant.

Gas oil at this plant is termed virgin charging stock. It is pumped to the cracking department storage tanks and charged from them into the four Dubbs units and into Cross units Nos. 6, 7 and 8. Nothing but raw or virgin stock enters these units. No recycle stock whatever is mixed with the charging stock for these seven cracking plants. The recovery of finished gasoline from their operation is 35 per cent. and sometimes better.

All of the recycle stock derived from the operation of these seven units is taken to separate storage and kept segregated from any other oils. After reaching storage it acquires a new name on company records. Colonel J. H. Graham, president, explained that this stock was just as pure as the virgin stock, but, having been used, they decided to term it "wedded" stock. It is certainly a unique term in the refining industry's plant accounting forms.

As wedded stock, this material, commonly known as recycle stock, is taken to separate charging tanks, and is charged into Cross unit No. 1, which is the new double unit erected on the site of the first Cross unit ever operated commercially. In this unit temperatures and pressures are slightly raised above those conditions existing in the former Cross cracking units, Nos. 6, 7 and 8, and, is of course, far different from the cracking conditions that prevailed in the four Dubbs units. This wedded stock is cracked or re-cracked and a yield of 33 per cent., and sometimes better, is secured in this second cracking. Cross cracking unit No. 5 is also used for cracking any surplus wedded stock, and alternates back on to virgin stock when there is no surplus.

RECYCLE OPERATION

It is necessary to digress here to discuss some of the features of the new double Cross unit just completed and but recently placed on the line. In May of this year it was decided to scrap the original

View of one side of the new double unit of Cross cracking process, showing utilization of old equipment for accumulator and evaporator and reaction chambers.

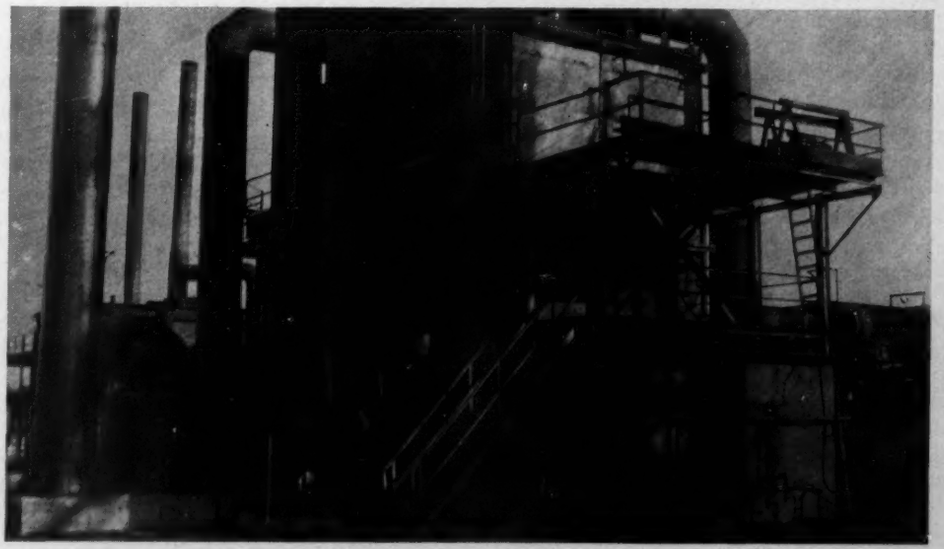
Cross unit and replace it, and its partner, erected in 1923, with a late unit, designed especially for the cracking of recycle stock. During the latter part of May the old plants were torn out and by the middle of August the replacement unit was in operation. Both of the old reaction chambers were preserved and are now operating on the new unit, hooked up in series to secure longer time on stream for the new plant. Company engineers take pride in the fact that this new unit is composed of much equipment of the class called discarded, and thereby they secured a low cost of construction figure for the new unit. Other than the brick, tubes, heat exchangers, bubble tower and hot oil charging pump, the equipment was formerly in use on the plant yard. The old equipment include accumulator or charging oil stock tank, evaporator, reaction chambers, control instruments, stack, a number of small pumps, and other items concurrent to cracking unit operation.

"Wedded" stock to be charged to this unit is first handled by two small steam pumps which deliver it through heat exchangers to what is termed an accumulator tank. In the accompanying photograph of the unit this tank is shown as the smaller of the three in line in the center. It is made of an old Dubbs reaction chamber too badly corroded for cracking service but good for a number of years in its present capacity. From this accumulator tank the oil is handled by a Wilson-Snyder hot oil pump, size 22 x 36⅜ x 4⅞ x 24 inches, discharging into the lower bank of tubes in the furnace. The photograph shows something of the large size of the new furnace. The lower bank of tubes is composed of 2¼-inch, I.D. tubes, and is about one-half the lineal footage of the upper or soaking bank, which is also of the same relatively small diameter. Small tubes are employed for the purpose of securing high velocity, less coke, and higher rate of heat transfer. The upper bank of something like twice the length of the lower is provided to secure the long soaking period with maximum operating pressure and heat that is desired. It will be noticed also that the furnace is fired through large dutch ovens instead of the usual method of firing Cross units at each end. These ovens are 14 feet long, five feet in height and 14 feet wide—and flame cannot reach the lower tube bank.

Pressure at the pump is maintained around 1100 to 1200 pounds. Temperature of the oil leaving the coil is 850 to 875 F. The entire unit was designed by the company's engineering staff. It is estimated roughly that the cost of material and labor, outside of the plant, was $35,000 to $40,000, and this low figure was secured by the utilization of equipment formerly discarded.

Leaving the heating and soaking coils the oil passes into the two reaction chambers which are hooked up in series, and which were formerly used on the old cracking units replaced by this new one. The use of two chambers provides for longer operating time and made the purchase of new equipment of this type unnecessary.

From the reaction chambers, where the coke is deposited, the flow enters the evaporator chamber, shown just behind the accumulator tank in the picture. This evaporator is an old Flemming unit still, pressed into service at the new unit. Vapors pass from the top of the evaporator and into the bottom of the Winkler and Koch bubble tower, shown last in the series of towers in the photograph. Temperature control is maintained in this tower by recycling benzine over it under automatic control maintaining an end point on the finished gasoline of 440 F. Gasoline produced from the operation of this unit, as well as all of the cracked gasoline, is taken to a shell still battery, after chemical treatment



This new Cross unit, which started operating in late August of 1928, stands on the site of the first commercial Cross unit in the world. Note the unit is fired through large Dutch ovens.

and steam distilled. This process will be described later.

TANDEM CHARGING

A furnace temperature of 1300 to 1400 is maintained, and being equipped with Leintz recirculating system, a stack temperature of 325 to 350 is secured. The coke formed in this operation, using wedded stock, is no harder than average Cross coke and it seemingly forms more slowly. The unit is operated for 15 days on stream, while the Cross units operating on virgin stock at this plant are on stream an average of eight days. The Dubbs units, charged with virgin gas oil, average nine to 10 days on stream. Residuum from Dubbs units is given a cleansing of carbon by the use of centrifugal machines, and marketed as a premium as low cold test fuel oil. The new unit, No. 1, being described, with its small tubes, is handling a daily average of 2400 barrels of wedded stock, when on stream. As previously mentioned, Cross unit No. 5 is also charged with surplus wedded stock and operated at like temperatures and pressures.

Going back to our discussion of operating in banks, or in tandem, there is still the operation of two more Cross units to be discussed. In the operation with virgin stock in seven cracking units, approximately 35 per cent. gasoline is recovered. In the second operation, two units on wedded stock, or recycle stock derived from the first operation, a gasoline recovery of 33 per cent. is secured. Then comes the third bank of cracking units.

Cracking stock for the last two units, or the third bank, is derived from the recycle stock produced by the operation of the second bank or Cross stills Nos. 1 and 5 just described. The reflux materials accumulating at the bottom of the bubble towers is taken to separate storage, none is recycled through the units. From this storage it is taken over to the refinery and redistilled for the removal of carbon and a general cleaning. Enough benzine is recovered in this step to pay the cost of redistillation, and about 70 per cent. overhead gas oil is removed, with a gravity of about 32 A. P. I. Bottoms are sent to fuel oil, first being centrifuged with the Dubbs residuum.

The cut of 70 per cent. gas oil taken from the redistillation of this recycle stock is then transferred back to the cracking department and is charged to Cross units Nos. 3 and 4. Here it is cracked in the third bank of the series, at slightly higher pressures and temperatures. The percentage of gasoline recovered in this final cracking operation, is 28 to 29 per cent. Recycle stock from this final bank or tandem is mixed with the Dubbs residuum centrifuged and sold along with it as low cold test fuel oil.

TREATING

As previously mentioned, all of the cracked gasoline produced direct from the cracking units has an end point of 440 F. It is given its first chemical treatment at the cracking units in a centralized treating system located in that part of the plant yard. While the gasoline is "live" and still warm—at or near its temperature of condensation—it is immediately passed through this treating plant. The system consists of nine treating columns, 40 inches by 20 feet in diameter, some of which are partially filled with caustic solution, the others with water for washing.

Experimentation has shown positively that if pressure products are stored as they come from the unit the chemical changes so detrimental to color and odor of the finished fuel begin within 24 hours—possibly sooner. For this reason the Indian Refining Company starts neutralizing and treating the cracked gasoline while it is as fresh as possible. All of the gasoline produced goes directly from accumulators at the unit to what is called surge tanks—horizontal containers located at the treating plant. From these it is pumped directly into the caustic treating system, about as fast as it is produced.

This practice prevents the starting of any deleterious chemical reactions with the gasoline itself. It also effects the immediate removal of any hydrogen sulphide in the condensates, and further it effects the removal of some sulphides and gums.

In addition to the above adventages this hot treat, and immediate treat, has contributed much to the lowering of pounds of acid per barrel of gasoline treated. Dr. Frank Fritts estimates that the caustic is twice as effective at this stage, and removes about twice as much impurities, and also contributes much to the stabilization of the finished gasoline.

HIGH BENZOL EQUIVALENT

The 440 end point cracked gasoline after its caustic treatment can be stored. From storage it goes to the continuous treating plant where it is first acid treated and then doctor sweetened. It is then ready for redistillation. This procedure is regulated to yield a gasoline of close fractions, having an initial boiling point as it comes from the stills of 94 F., 90 per cent., at 355-360, and an end point of 400 to 405 F.

It is said that the Cross and Dubbs gasoline produced in the manner described can be made to have a higher than 40 per cent. benzol equivalent or anti-knock value, for it is held down to this figure in order to avoid gum troubles. This is in line with the present practice of the majority of refineries.

Illinois crude of 32 gravity is charged to the skimming plant. From this crude a total of 59 to 60 per cent. of gasoline is recovered. A peculiar coincidence is found in the fact that the cracking department, operating its units in tandem or in banks as described, produces gasoline at the yield figure of 59 to 60 per cent., based on the barrel of charging stock coming to it from the skimming plant. Straight distillation of the crude oil, or skimming plant practice produces a yield of 28/29 per cent. straight run gasoline from the Illinois crude—which figure is slightly higher than the Hempel distillation recovery in the laboratory.

California Gasoline Association Meets November 13-14

The second annual fall meeting of the California Natural Gasoline Association will be held at Los Angeles November 13 and 14. Four papers will be read the first day, while the entire second day will be given over to an address by Dr. George G. Brown, professor of chemical engineering at the University of Michigan, and director of research for the Natural Gasoline Association of America.

The Vapor Pressure committee of the association has prepared a paper which deals at length with most accurate methods of determining the vapor pressure of natural gasoline. The paper will be read by H. S. Wade, chairman of the committee.

"Use of Gas and Gasoline Analysis in the Practical Operation of a Gasoline Plant," will be discussed in a paper prepared by the General Analysis committee and read by A. J. L. Hutchinson.

J. C. Bolinger will read a paper on "The Compression of Gasoline Plant Vapors."

A banquet will be held in the new ball room of the Biltmore Hotel on the evening of the second day.

General view of the Pure Oil Company's Marcus Hook complete refinery. Light oil equipment to the left, and heavy oil plant on the right of the picture. Docks in the background.

Pure Oil Plant at Marcus Hook Complete Unit

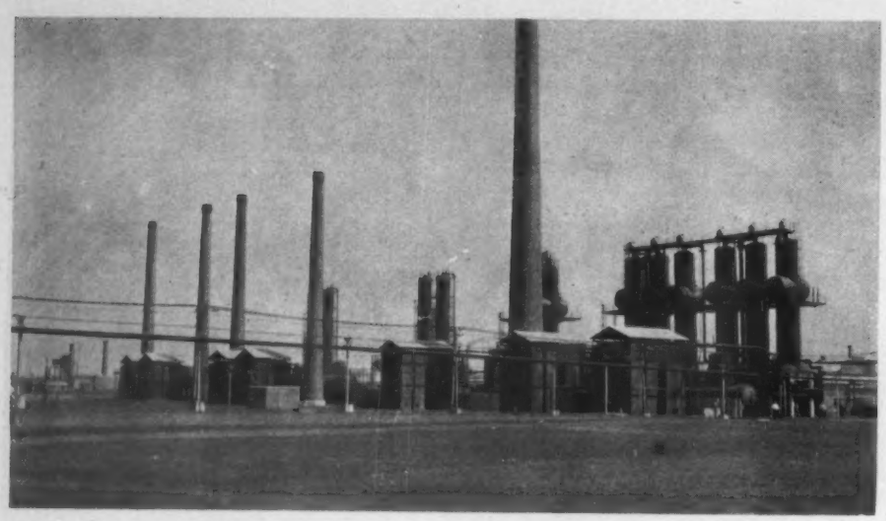
By GEORGE REID
Associate Editor

THE seaboard refinery of the Pure Oil Company at Marcus Hook, Pennsylvania, is a complete plant, consisting of skimming, cracking, lubricating and wax manufacturing departments. Crudes are shipped to its docks by tanker from such fields as Ranger, Sweet Lake and Seminole. The refinery is being enlarged at present through the addition of a complete grease plant, as well as new filtering plant, in preparation for the manufacture of lubricants from Pennsylvania crude.

The Marcus Hook plant is divided into two distinct departments. In the accompanying areial photograph a white line is seen running through the central part of the yard. To the left of this white line is such equipment as is required for the operation of the skimming and cracking departments. To the right the equipment is given over to the manufacture of lubricating oils and consists of stills, tankage, chemical treating equipment, refrigeration plant, wax plant and contact filtration unit. To this part of the plant is to be added the new percolating type filter plant, the furnaces for burning Fuller's earth, and the new three story grease plant. Further, a new Sharple super centrifuging dewaxing plant consisting of seven of the new type vapor tight centrifuges is being installed.

As one enters the plant there are two buildings constructed of brick, concrete and steel, of exact dimensions. The building to the right houses the offices, and that to the left is the modern fire-proof laboratory. This building contains heavy oil testing and flash rooms, light oil routine testing and flash rooms, experimental laboratory, wash rooms, sample filing room, analytical room, stock room and first aid station, as well as the office of the chemist. The rooms are large, commodious, well lighted and ventilated, and all modern instruments and conveniences are placed at the disposal of the staff of chemists.

Again referring to the illustration—in the center of the triangle formed by the three large steel stor-



Skimming and cracking equipment at Pure Oil Company's Marcus Hook refinery.

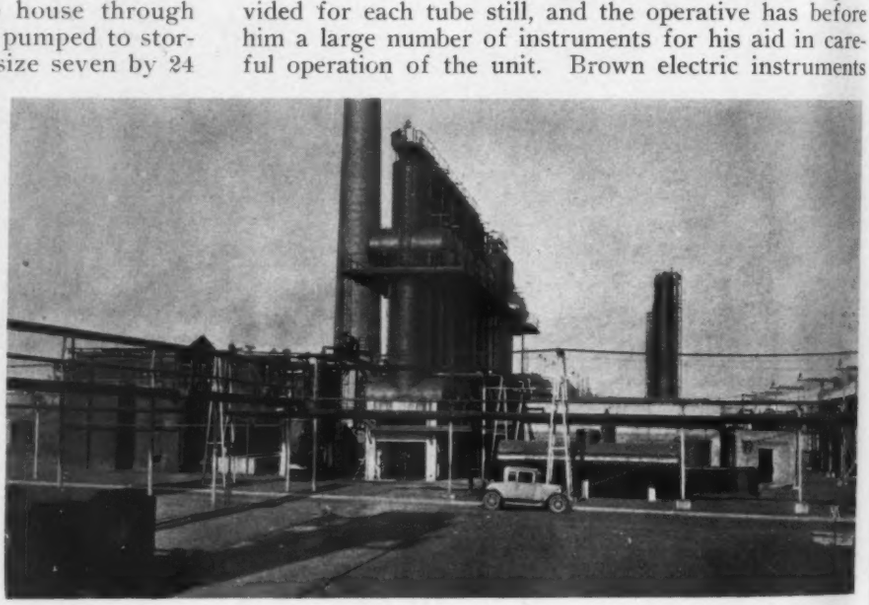
age tanks there appears the pump house through which crude received at the docks is pumped to storage. Two National Transit pumps size seven by 24 inches, H.D.P.B., motor driven and operated by gear connections, are employed in unloading. The motors are 200 horsepower. These pumps place the crude in storage, either in five fifty-fives on the plant yards, or into 18 fifty-fives which comprise the company's tank farm four miles from the plant. The various crudes received are stored separately, and are not mixed until operations require some particular blend. This plan leaves such crudes as Ranger, for example, uncontaminated with other crudes, so that lubricating oils may be processed.

In the same pumphouse there is a National Transit pump 18 by 5 by 18 inches in size which delivers fuel oil from plant storage to the plant of the Bethlehem Steel Company 70 miles distant.

SKIMMING EQUIPMENT

Skimming plant distillation equipment consists of three Foster pipe stills having capacity of 5000 barrels each. Working in conjunction with the stills are three large fractionating columns of the usual Pure Oil Company design and type, and an evaporator. Heat exchange is secured through two reflux sections in each of the towers, and then through heat exchange with residuum flowing from the evaporator. Crude is flashed of a large percentage of its gasoline content before it enters the tube still through one of the towers. Reboilers are installed in each of the towers. The system is what is commonly known as the multiple flash method of distillation and secures excellent economy of operation. The stills are built of four inch tubes.

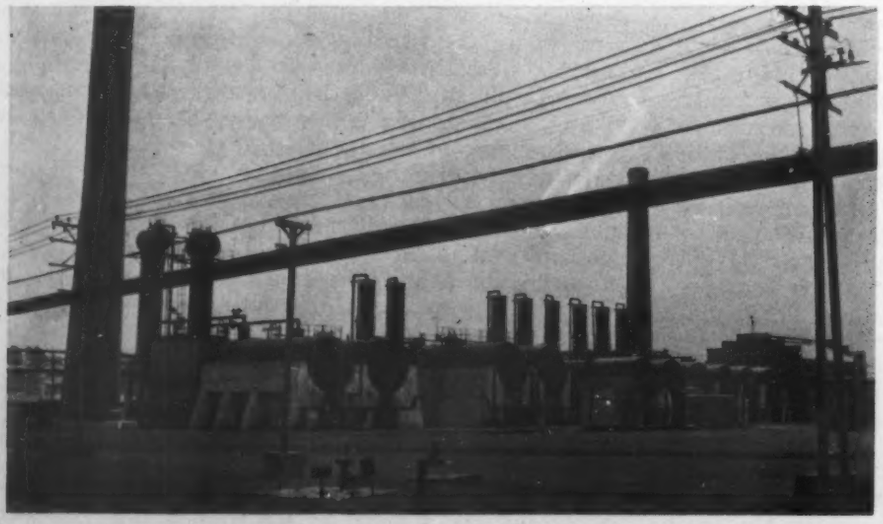
A separate control house is provided for each tube still, and the operative has before him a large number of instruments for his aid in careful operation of the unit. Brown electric instruments



Fractionating columns operating on multiple flash system in conjunction with pipe stills.

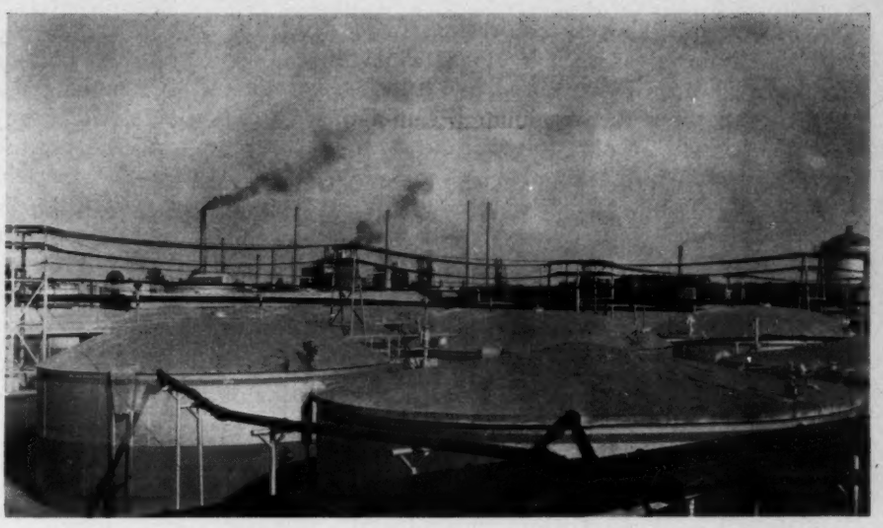
are used, and there are eight recorders on each still—two temperature indicators showing temperature of the still sides, two pressure recorders per still, two draft recorders, front and back, a CO_2 recorder, and stack temperature recorder. The control houses are small, built of brick, concrete and steel, for safety and proof against fire, and are steam heated in the cooler weather.

A pump house is also provided for each unit, or tube still, which is an excellent idea where independent operation is desired and where each unit is handling such large quantities of oil. Further control devices are placed on a centrally located board for the guidance of the operatives. Recorders are installed showing the tower top temperatures, and working in conjunction with automatic temperature control devices. Temperatures from nine other points are indicated. Pressure



View of heavy oil distillation side—power house to extreme right.

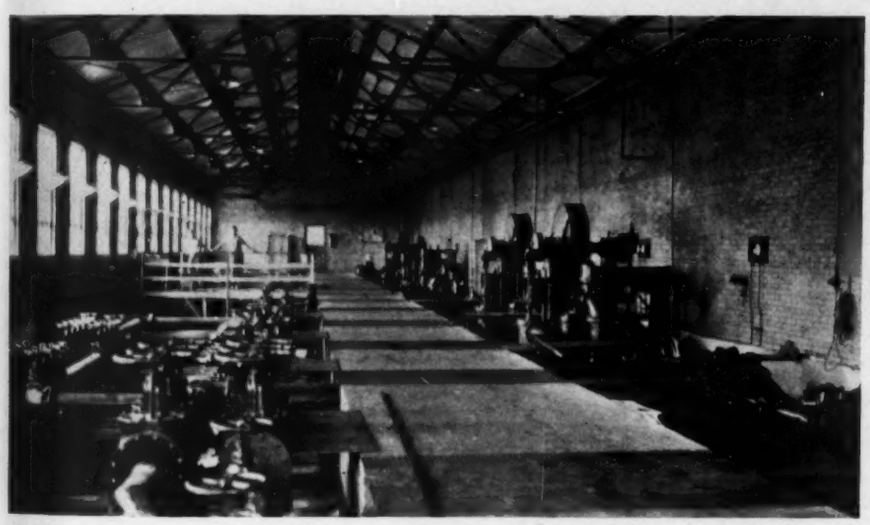
gauges indicate the pressure of flowing oil, and flow meters are installed. The pumps are electrically operated with steam auxiliary equipment. National Steam Simplex, and National Transit Triplex pumps are employed for charging oil to stills, and two Goulds triplex pumps handle the residuum or topped crude. Electric variable speed motors drive the pumps charging oil to stills, of Crocker Wheeler type equipped with Tex Rope drives. Tex Rope drives are being installed throughout the plant.



Looking out over the vapor tight tanks from receiving house. Note cast iron run down lines and flanged connections.

TUBE STILL OPERATION

Tube still operation at this plant is very flexible and this flexibility of the plant is abetted by the fact that each of the five thousand barrel units is in reality a complete skimming plant in itself. Usually two cuts of gasoline are taken from the stills, or towers, one gas oil fraction for utilization as cracking stock, and a wax distillate cut, which may be either charged to the cracking units, or cracked in the shell stills for pressuring and the lubricating oil recovered. Kerosene is made when needed by a slight change in the operations. Crudes may be processed separately or blended. At the time of the writer's visit a blend of Sweet Lake and Seminole crudes was being processed. The attacks of corrosive elements and compounds are combatted by the injection of 6 Be. caustic solution into the vapor lines near the point where they leave the tower shell. This practice greatly increases the life of the condenser coils, and effects the neutralization of acidic compound at the time they begin to condense —at which time they are the most active in their reaction with the metals.



Interior of main light oil pump house. Motors for driving all pumps are located on the other side of the wall.

CRACKING METHODS

The cracking equipment at this plant consists of four of the larger types of Cross units. They have a rated capacity of 2000 barrels each and are equipped with the heavy reaction chambers, 40 feet long. The company is operating these units at 3400 to 3500 barrels throughput per day, charging with two large pumps in simultaneous operation. They were installed originally with the intention of employing but one pump and using the other as auxiliary or stand-by equipment, and one is steam driven, while the other is electrically operated.

Charging stock flows from the pumps upward through two-inch coils inside of the fractionating columns and picks up heat from the rising vapors. From the heating sections the oil flows into the preheater bank of tubes, then through the roof tubes into the cracking bank and to the reaction chamber. From here it is conducted into a reboiler at the bottom of the tower, and then to the evaporator. Vapors from the evaporator pass into the bottom of the tower and in ascending, preheat the charging

Tanker at the Marcus Hook Dock.

stock as described above. The reflux condensed in the tower is employed as recycle stock, while the vapors passing overhead are condensed into finished gasoline. At the evaporator the residuum accumulating at the bottom is removed, cooled and taken to storage.

A gasoline recovery plant of the compression type extracts the gasoline from fixed gases derived from the cracking unit operation. Vapors and gases from tube stills, receiving houses and light oil tanks are also taken to the recovery plant. Two compressors, one Laidlaw and one Ingersol-Rand, produce an average of 5000 gallons of gasoline daily.

An accompanying illustration shows the interior of the light oil main pump house. In this building, as well as throughout all departments of the plant, strict cleanliness is strikingly noticeable. The equipment in this house has been in service for a number of years, yet it has the appearance of being but recently installed. There are four Deane Triplex pumps, and six centrifugal pumps, as well as two small booster pumps which discharge cracking unit charging stock drectly into the large charging pumps at the units. All of the pumps are electrically operated, with the motors located in a separated room. A pressure gauge is provided for each pump on the discharge side. All of the various products are handled through separate manifolds in the usual manner.

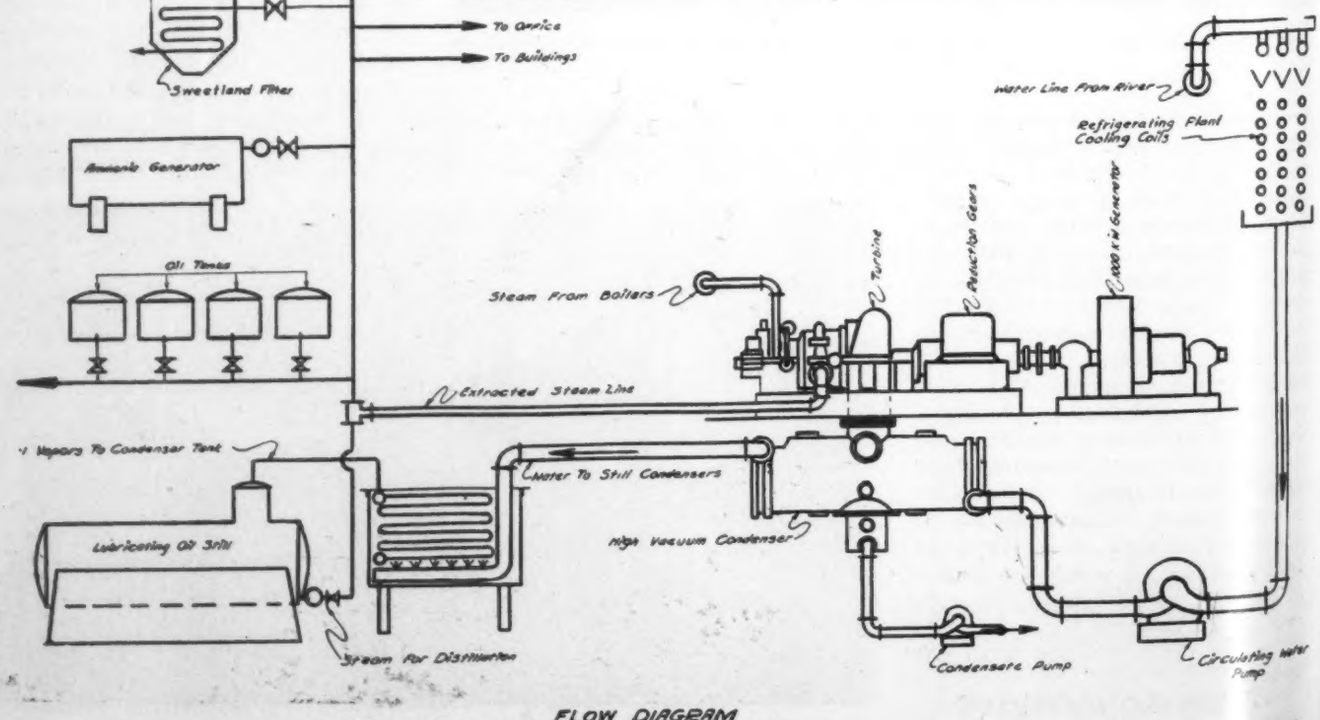
On the heavy oil side of the plant there are 10 shell stills in which the oils are cracked or reduced as the needs may be. Run down lines from this receiving house, as well as the run down lines used on the light oil side of the plant, are of cast iron with flanged joints. Cast iron is very resistant to corrosive substances.

HEAVY OIL PLANT

The heavy oil plant has been making four neutral oils and wax. Neutrals are made from Seminole crude. This crude also yields a good grade of wax. All of the crudes used are processed on the heavy oil side, the lube distillate being processed separately and the products handled separately. There are six batch-type acid treating agitators from which the oil is taken to the contact clay filtration department. Two Sweetland presses are in use, both equipped with compressed air devices for dumping the presses when full. Two 100-ton Carbondale, one 30-ton and one 70-ton refrigerating plants are in service. One hundred and thirty tons are used on wax. The 70-ton plant will be used on the Sharples centrifuge plant when installation is completed. For pressing the wax there are four 48-inch and three 36-inch Carbondale presses.

The company has in operation an electric generating plant which supplies current for the operation of all of the motors on the plant, as well as lights on the plant yard and office and other buildings. The fact that an oil refinery making lubricating oils always has a large number of places where low pressure steam is as advantageous as high pressure steam makes possible the installation of a bleeder or extraction type of steam turbines for the operation of generators, and because of these peculiar conditions this type of prime mover will successfully compete with any other type in economy and first cost. A. E. Harnsberger, of the company staff, in discussing the installation says:

"The unit installed and at present in operation is a 1460 horsepower Kerr steam turbine, rotating at a speed of 3600 R.P.M., driving through a single reduction, herringbone type reduction gear, a 1000 kilowatt capacity Crocker-Wheeler 250 volt D.C. generator. Auxiliary equipment consists of a Worthington 2240 square feet, three pass surface condenser



FLOW DIAGRAM
MARCUS HOOK-POWER HOUSE

of the divided water box type, which permits operating one-half of the condenser while cleaning tubes of the other half. This is a very desirable feature since it permits the cleaning operation to be performed without shutting down the turbine. On account of the sediment in Delaware River water, this cleaning operation is performed about once a month.

"High vacuum is maintained on this condenser by means of a Worthington two stage steam-jet air ejector. The efficiency of the condensing equipment is high since operating records show that in winter with cold circulating water, a vacuum of less than one inch absolute is maintained with ease.

"The power plant is also equipped with a centrifugal circulating pump having a capacity of 1500 gallons per minute, and two condensate pumps, one steam driven and the other electric driven, each having a capacity of 50 gallons per minute.

"Referring to the diagram shown, an idea can be obtained of how the plant operates. Steam enters the turbine through the line indicated at a pressure that averages 145 pounds per square inch and 150 degrees of superheat. After passing through the first four stages of the turbine the pressure is reduced due to the expansion through the nozzles. At this point in the turbine there is a built-in grid valve which is automatically controlled by the steam pressure that is desired to maintain in the extracted steam line, shown in the diagram. At present this pressure is maintained constant at 25 pounds gauge. That portion of the steam which does not pass out through the extracted steam connection continues past the grid valve and expands through the remaining eight stages of the turbine to the condenser vacuum, which averages 1½-inch absolute under ordinary circulating water temperature conditions. The steam having been condensed is removed by the condensate pump and delivered to the boiler feed water heater where it is again converted into high pressure steam."

WATER SYSTEM

Instead of pumping water from the river the entire distance to the generating plant, water for use in the condenser described above is taken from the refrigeration plants after having been used there. In its passage over the cooling and condensing coils used in connection with the two 100-ton absorption type refrigeration machines, this water is not heated more than five degrees above its original temperature. It is still sufficiently cool to pass onward to the nearby turbine condenser by means of the centrifugal circulating pump and employed again for condensing steam.

The water, however, is not yet through working. It is taken to the lubricating oil stills where the warm water from the turbine condenser discharge is well suited for condensing and cooling the wax and lubricating oil streams. Thus, the water is used three times—first for refrigerating purposes, then for condensing steam, and later for condensing and cooling the oil vapors.

Again quoting Mr. Harnsberger's discussion of the new plant:

"As above stated, steam is extracted from between the fourth and fifth stages of the turbine at 25 pounds pressure. This part of the steam in expanding to 25 pounds pressure from the initial 145 pounds has performed a considerable amount of work in the turbine and has served to place many additional kilowatts on the switchboard. In its passage through the first four stages it has lost only 80 B.T.U.'s per pound of its original heat, thereby making it almost as valuable for heating purposes as the high pressure steam generated in the boilers, when it is considered that the steam leaving the boilers has available a total of 1277 B.T.U. per pounds for heating purposes. A very accurate record has been kept by use of flow meters of the quantity of high pressure steam that enters the turbine and the quantity of 25-pound steam that leaves through the extracted steam line. Over the year 1927 the average high pressure steam to the turbine totalled 10,876 pounds per hour, and the amount extracted averaged 7,200 pounds per hour. However, due to its passage through the turbine the extracted steam has lost some of its heat, as above mentioned, and is therefore equivalent to a reduced amount of high pressure steam in heating value. It should therefore be reduced by 6.7 per cent, or giving an average of extracted steam in terms of high pressure steam as 6718 pounds. The quantity of steam chargeable to the turbine is the difference between this value and the total high pressure steam, or 4158 pounds per hour. The yearly average of the load was 442 K.W. per hour which means that the plant produced an average for the year of a kilowatt on 9.4 pounds of steam per hour. This is considered exceptionally economical performance."

Labor for producing power is not of high cost, since but one man is required on each shift to look after the operation of the unit. The low pressure steam extracted from the turbine is used for a number of purposes about the plant. Part of it goes to the lubricating oil distillation shell still equipment, not far distant from the turbine. During the cold months much of the steam is used in the work of keeping lubricating oil and wax distillates in storage warm enough for easy handling. The greater quantity of the low pressure steam is used by the ammonia generators in the refrigeration plants. The Sweetland filter contact clay plant also uses some of the low pressure steam to heat up the oil to proper contacting temperature. Still more of it is utilized in the heating of the laboratory and office building—and the laboratory uses a certain quantity of it in its routine and experimental work. Several other small buildings are heated by this steam during the cold weather.

Although the average load is slightly less than half of the generator rating, it must be borne in mind that there are peak load conditions to be provided for. When two large 200 horsepower motors are put to work unloading tankers once in every ten days, the peak loads run as high as 850 K.W. Weather conditions tend to increase the load at times. Installation of the new filter plant, the three story grease plant, and the new Sharples centrifugal dewaxing plant will all tend to raise the average load on the generating plant in the near future, and these conditions were anticipated when the plant was designed and installed.

Specifications for Suitable Mixing Tank for Contact Filtering

By H. L. KAUFFMAN

THE most important advantage to be gained by so-called "contact filtering" of oils with finely-divided clays—as opposed to percolation methods—is that of time, an advantage that is due to the greater speed in obtaining the same decolorizing effects. Adsorption, and particularly the adsorption of colored bodies, proceeds much faster when the clay is used as a fine powder than when employed in its coarse state (e.g., 15-30 or 30-60 mesh). But—and note this especially—the completeness of adsorption depends upon the intimacy of the contact between the particles of clay and the oil. In plant operation intimate contact is facilitated by:

1. Heating the oil to reduce its viscosity.
2. Agitation of the clay and oil when the water contained in the clay is changed by heat into steam, and as such rises to the surface—agitating the mixture while so doing.
3. Use of suitable mechanical mixing devices, such as by pump re-circulation, stirring devices, or both.

Not all types of mechanical stirrers will satisfactorily agitate fine clay and oil. Intimate mixing must be accomplished rapidly, since the decolorizing reaction is a reversible one; consequently, a lengthy period of contact will cause some of the adsorbed impurities to be thrown back into the oil.

It is the purpose of this article to describe the design and construction of a suitable mixing tank for contact filtering oils, including in same information relative to the tank proper, agitating mechanism and tank insulation.

PROCESSING SYSTEM

In the contact system of filtration, wherein dry clay of fine mesh is used as the decolorizing material, the processing of the oil is approximately as follows:

The oil after acid treatment in the agitators, with or without subsequent partial or complete neutralization with caustic soda, soda ash or other neutralizing agent, is pumped to an open top mixing tank in the filter house. Agitation (either by pump or re-circulation, mechanical stirrers or both) is started, after which the necessary amount of clay is added to the oil in the tank. The quantity of clay used is dependent upon the nature of the oil and the extent to which the product is to be decolorized. Ordinarily, the mixing tank is suitably arranged for heating to temperatures as high as 250 to 300 degrees F.; or, the tank may be connected to a pipe still, in which case provision for heating the oil only to 150 to 180 degrees F. is all that is required.

After all of the clay has been added to the oil agitation (or mechanical stirring and re-circulation, where provision has been made for both) is continued, while at the same time the temperature is gradually raised to the point at which a maximum decolorizing and deacidifying efficiency is obtained from the adsorbent. When a pipe-still is not a part of the system, the oil is held at the desired temperature in the mixing tank until the evolution of steam has ceased, and then for approximately 10-15 minutes additional time, continuing agitation.

Thereafter, the clay-oil mixture is filtered while hot through suitable filters to remove the clay. The cloudy oil first coming from the filter presses is passed either directly back to a tank containing un-filtered oil, or to an intermediate tank planned to hold the cloudy product for subsequent re-filteration—the "cloudy oil" receiving-tanks being changed as soon as a clear oil results from the filtering operation.

DESIGN AND CONSTRUCTION

The essential features of the design of a 50-barrel mixing tank suitable for use in contact filtering oils are given below.

The tank is 7 feet 6 inches by 17 feet 9 inches in size, 12 feet 8 inches in the straight shell. Heating is accomplished by high-pressure steam, which is passed through a welded pipe coil, five feet in diameter, made of 14 turns of 1½-inch standard steel pipe, having a five-inch pitch and held in place by two-inch by ⅜-inch coil straps and hangers. Such a tank with coils and stuffing boxes, but without stirring mechanism, can be obtained for about $1400.

In a mixing tank of the size described in the foregoing (that is, 7 feet 6 inches diameter by 12 feet 8 inches high in the straight shell), efficient mixing of the clay and oil can be obtained by using a stirring device of the special cyclone type, consisting of the following units:

1. One three-foot shaft.
2. Five torpedo propellers, the first of which is four feet from the top of the tank.
3. One 24-inch diameter stirrer cylinder with necessary legs for support.
4. One step bearing.
5. One thrust bearing.
6. One bevel gear reduction and pulley for belt connecting to a 7½-h.p., 1200 r.p.m. motor.

Such an agitator shaft, so connected, will have a speed of 200 revolutions per minute.

The mixing tank should be further provided with a suitable cover, one section of which should be hinged and provide with locking hasp and handle; the other should be bolted down with ⅝-inch bolts on six-inch centers.

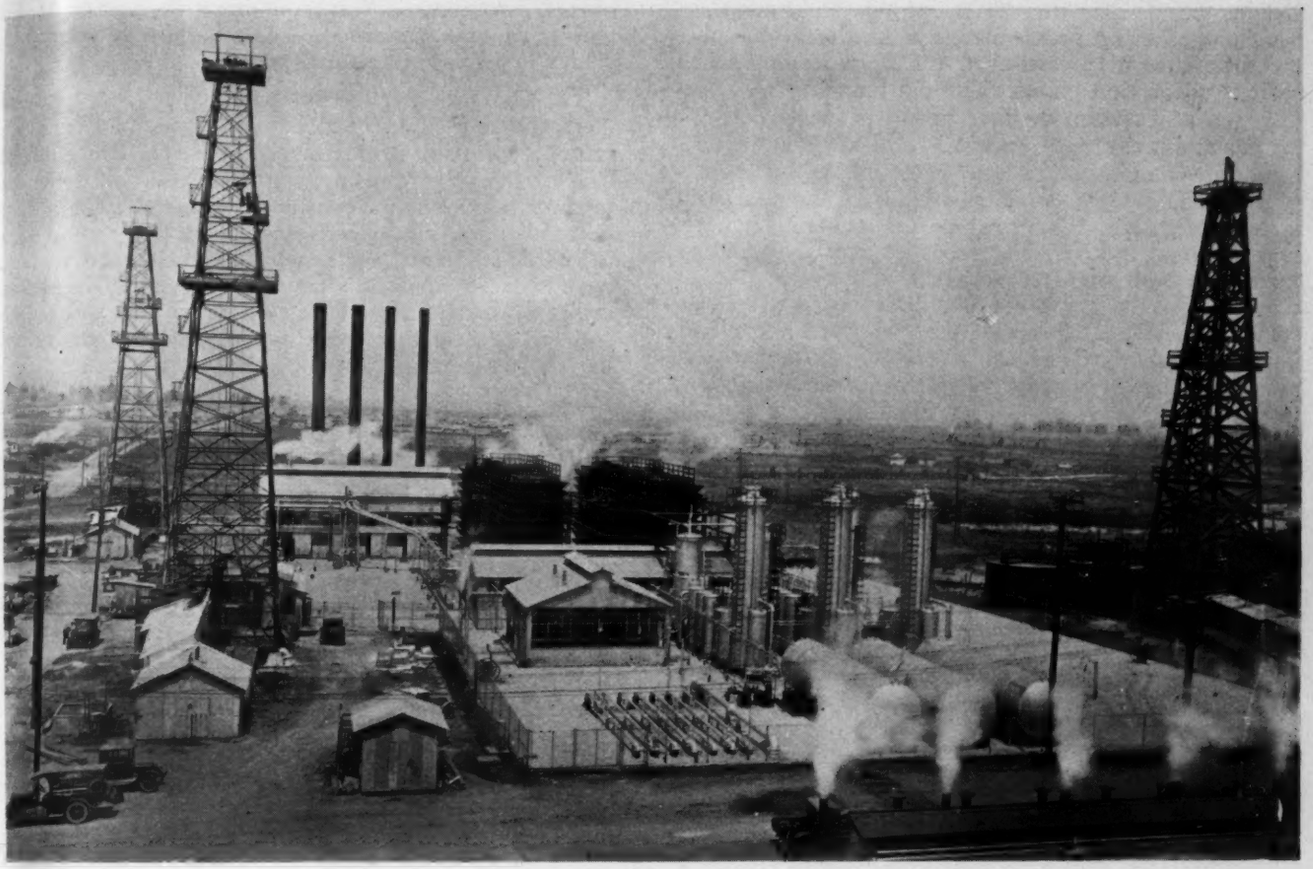
In order to dump clay into the tank with the cover closed a clay-inlet bin, at least 12x12 inches in size, should be provided. The bottom of the tank should be cone-shaped, making a 45-degree angle.

A stirring device of the type described, with cover to suit, can be obtained for about $550.

IMPORTANT SPECIFICATIONS FOR MIXING TANK

In placing an order for a tank such as has been described in the foregoing, the purchaser should insist on the following:

(*Continued on page 74*)



The Texas Company's No. 5 Plant at Signal Hill, California

Varying Line Pressures Controlled In Long Beach Plant

By BRAD MILLS
Staff Representative

USING the latest and most efficient equipment to carry out the unit idea of construction, The Texas Company has created a new standard of natural gasoline plant design with its No. 5 plant in the Long Beach field. By incorporating the latest ideas, with many individual and original ideas thrown in for good measure, the company has overcome many problems common to the average gasoline plant.

The decision to erect the plant was reached after a careful study of the field indicated that the impending flood of crude was sure to bring a surplus of natural gas. Prior to the development of the deep sand, The Texas Company had considered shutting down some of its five Long Beach plants as a retrenchment policy. The completion of the first wells in the deep zone reversed this plan, however, and the company immediately conceived the idea of a centralized plant to care for the surplus gas. Plant No. 5 is the result of this decision.

When the plant was designed, the fact that it would be forced to operate under constantly changing conditions was considered first of all. It would be called upon to handle gas under varying pressures from the wells and field lines. It must be a centralized absorption plant which could receive gas from the various booster plants about the field, the overflow from compressor plants, and gas direct from the wells. Realizing that production would decline rapidly from the peak, the plant was located so that it could be used as the central and major unit when the older absorption plants were no longer needed, except as booster units.

The unit design was adopted to insure flexibility and to meet conditions as they might arise in the future. Only two units have been built, but they have been constructed so that additional units may be added if necessary. Each of the present units has a capacity of 12,500,000 cubic feet of gas and about 30,000 gallons of gasoline, with an extreme capacity somewhat larger. The plant is so standardized that it may be added to in units of exactly the same capacity as those now in operation. Likewise, either of the present units may be shut down without affecting the other. The heat exchangers, pumps, scrubbers, rectifying columns, stills, fractionators, absorption and distillation units, preheaters, cooling towers, reflux tanks and even the boilers can be made independent in each unit.

VARYING WELL PRESSURE

The chief engineer did not depend wholly upon himself for all phases of the plant design, but discussed the

various problems with the operating department. A peculiar gathering problem existed in the field, due to the difference in pressure on the lines leading to the various absorption plants. The old pumping wells furnish gas at vacuum, another group of wells delivered the gas at a pressure of 10 or 12 pounds, while the latest producers maintained a line pressure as high as 50 pounds. This wide variance required three separate systems of gathering lines, which still exists. It is necessary to boost the first and second stage wells, but gas from the best wells is delivered directly to the absorbers. Peculiar pipe line conditions had to be overcome. A vertiable cluster of pipe lines of almost every imaginable size crossed the site selected for the compressors. Due to general congested conditions not permitting going around, a huge ditch was dug and the pipe lines placed under the compressors.

The plant was completed February 5 and its efficiency has exceeded even the fondest expectations. In neatness and appearance its rating is very high. Buildings, towers and overhead carriers are compactly designed to occupy a minimum of space.

The boiler plant, often referred to as the heart of an absorption unit, is a marvel of completness and embodies almost every improvement to increase efficiency and eliminate costly shutdowns. The arrangement is such that the chief causes of boiler plant troubles are removed before they have a chance to take their usual toll. Two, 250-horsepower and two, 157-horsepower Badenhausen water tube boilers, operating at about 195 pounds pressure and capable of developing almost twice their normal rating under extreme conditions, furnish ample power for both units. At 150 per cent. of their normal rating these boilers deliver steam at about 20 degrees super-heat. Mettler low-pressure gas burners are used. Merco-Nordstrum three-way safety cocks have been installed to prevent gas from accumulating when the fire is out. Copes boiler feed regulators are used to keep the water at the correct level at all times. A Lee steam turbine drives a Gould centrifugal pump to furnish the water supply.

Although there is no direct connection between the pump and turbine and the feed water regulators, one is largely dependent upon the other for efficiency. As the water supply is lowered in the boilers, the feed water regulators open, allowing the turbine pump to increase its speed. The entire arrangement works on the regulator principle. Two American-Marsh duplex pumps are used as auxiliary or emergency boilers feeds. By the use of two large Worthington-Stillwell water heaters, water is sent to the boilers at temperatures as high as 215 degrees. As a precaution against impure water, Permutit water softeners are used to neutralize harmful chemicals. As a further precaution against bad water, Braun grease extractors have been installed These clever devices also remove all foreign matter. Tycos Pyrometers constantly record boiler water temperatures. As a check on the efficiency of both the boilers and the plant, all outgoing steam is measured by orifice meter.

PUMP HOUSE

The pump house carries out the unit idea throughout. The equipment includes three Lee turbine water pumps, one for each unit and one for emergency; two 6x4x6 reflux pumps, five 9x8½x10 duplex pumps, two of which are used for lean oil, two for fat oil and one for emergency; two, 850-gallon reflux tanks, two run tanks for separating water and gasoline, and two high pressure accumulators. Neilan-Schumacher external kidney float controls for maintaining the proper level in the reflux tanks are used. The auxiliary equipment includes two 7x3½x8 duplex pumps.

The chart and gauge room is centrally located and might be termed the nerves of the plant. Steam agitation to each still is recorded by Westcott orifice meters. The Foxboro thermostatic control is used on each fractionator to maintain a constant end-point. Each absorption tower has an orifice meter for measuring the quantity of oil circulated. Guesswork and haphazard methods have been eliminated by charts and gauges. A Meriam manometer controls the distribution of gas to each absorber. Leeds and Northrup potentiometers for recording the temperatures in the rectifiers are used.

The absorption and distillation units, heat exchangers, weathering tanks, vent tanks, evaporator stills, fractionators and manifold headers were designed and installed by the company. Badger rectifying columns, Campbell wash scrubbers, Southwestern pre-heaters, Fluor cooling towers and a specially designed Ereco fractionating drip still complete the heavier equipment.

The cooling towers are a departure from the usual design and were built for conditions at Long Beach. They are built so that all hot liquids and vapors enter one end. The cool ends of the towers are pointed toward the ocean so that the prevailing wind will strike these ends first. In this way much of the heat given off is prevented from sweeping toward the cool end, and incidentally the breezes are cool when they contact the hot end.

The special fractionating still was designed by the Engineering Research and Equipment Company and is used for handling drip gasoline, which is condensed in the process of getting the gas to the absorbers. It has proven to be a very satisfactory arrangement.

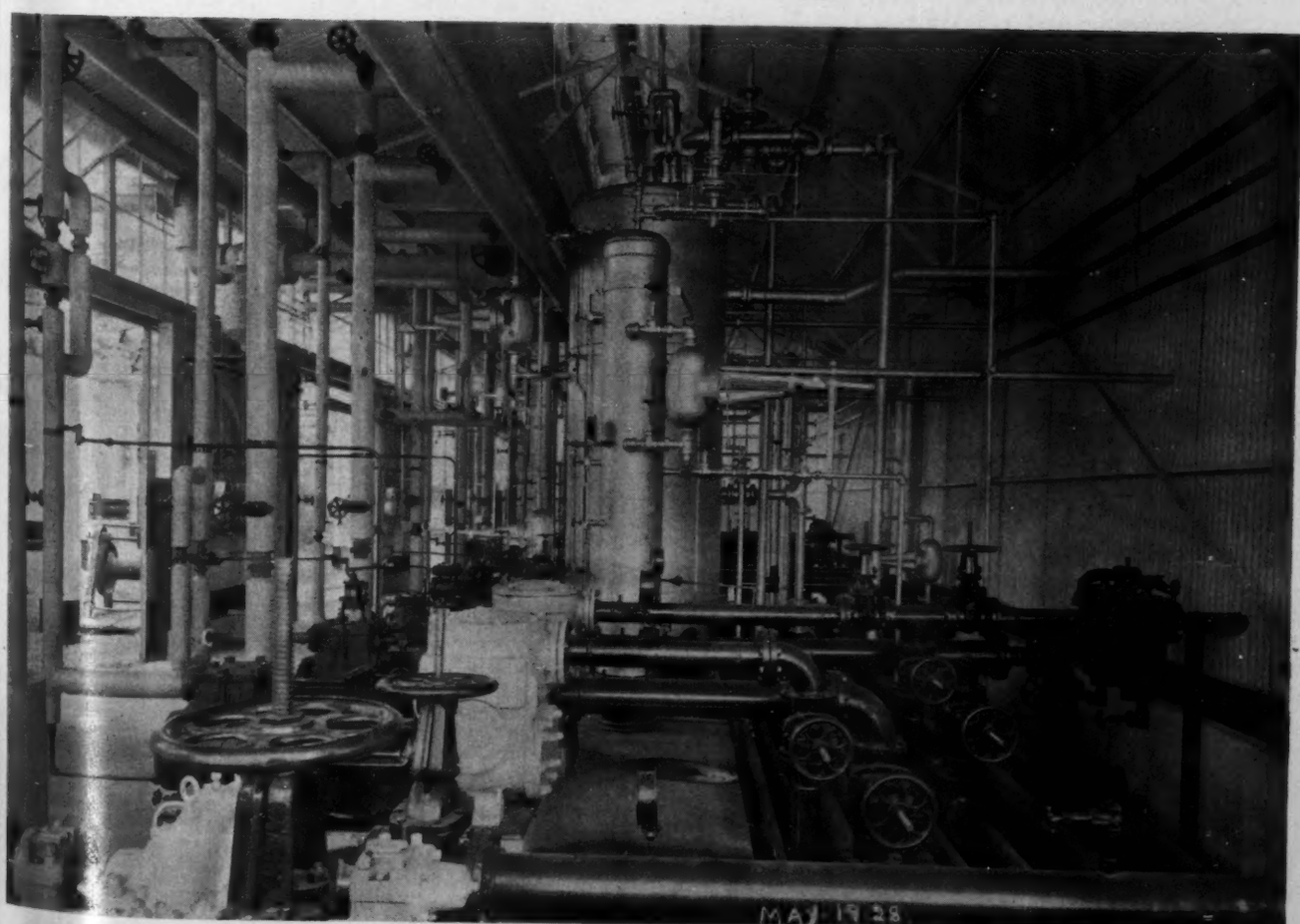
Two, 90-horsepower Clark compressors are used for re-compressing the uncondensed gas from the run tanks and for sending this gas to the high pressure accumulators.

To eliminate much of the trouble in the absorbers, all foreign matter is carefully strained from the oil as it comes from the cooling towers.

The compressor plant consists of seven, 190-horsepower, twin type, direct drive, 18x20 Clark compressors and two, 165-horsepower, twin type, 18x20 Bessemers. In case of emergency, the plant has the use of 11, 165-horsepower, belt driven, twin type Bessemers, with Ingersoll-Rand compressors which normally handle gas for another plant.

As the gas enters the plant, it is measured by one large meter. This meter must check within two per cent. of the total amount registered by the smaller meters on the various sources of supply. A 16-inch manifold carries the gas to the large absorbers and the stand-by absorber, by way of the wash scrubbers. These individual wash scrubbers are designed so that gasoline may be circulated from the bottom through perforations to remove oil and solids from the gas, greatly increasing the efficiency and the life of the absorption oil. The gas enters the bottom of the absorbers and leaves the top of the absorbers to enter the dry gas header on its way to the dry gas meter manifold or header. This header is arranged for istribution to the plant fuel, field fuel or sales. The plant is assured a constant fuel supply by a special regulator arrangement. Other needs are filled in the order of importance, the final meter being set to blow off surplus gas. The regulators on this dry gas manifold are graduated in a very ingenious manner.

Absorption plant, showing hook-up of one unit.



Pump house, The Texas Company's No. 5 Plant.

Determining Loss of Head Due to Friction in Water Pipes

WATER is used in oil refineries for three general purposes:

1. In the operation of process units, mostly for the condensation of vapors, or cooling of liquids or washing of oils in treating.
2. In boiler-houses for steam generation.
3. In "fire-protection" systems, where it is an invaluable aid in cooling adjacent buildings and tanks, as well as for preserving the lower shell rings of a burning tank.

It is well known to every refinery executive how vital is the question of water-supply in plant operation.

Bell[1] gives the following analysis (Table 1) of the water consumption of eight plants of five different companies, showing the water consumption in gallons per 24 hours per barrel of crude run to be:

TABLE 1

	Water consumption in gallons per 24 hours per barrel of crude run
1. Complete lubricating refinery	540
2. Complete lubricating refinery	630
3. Skimming and cracking	910
4. Half skimming, half lubricating	250
5. Topping, only 25 per cent	210
6. Lubricating refinery	440
7. Complete refinery	800
8. Complete lubricating refinery	1020

And then continues:

"Numbers 3, 7 and 8 were handicapped by an unusually warm supply of water, 70° to 75° F. being reported in summer. Plant No. 4 cooled and re-circulated most of the water, with consequent low consumption. For normal conditions, with water temperatures over the year of from 50° to 60° F., the writer (Bell) recommends 650 gallons per day for complete lubricating refineries and 300 gallons per day for skimming plants, for each barrel of crude oil put through the refinery."

[1]Bell, "American Petroleum Refining," p. 409.

The foregoing discussion gives some additional idea of the importance of the water system in the construction and operation of a refinery. As a matter of fact, in locating the site of a refinery, the quality and the quantity of the water available for use frequently determines where the proposed refinery shall be located.

WATER PRIMARY CONSIDERATION

An adequate water supply delivered to the point of consumption at a sifficient head pressure is of utmost importance to successful refinery operation. In the construction of new plants, then, the lay-out of a suitable water-supply system demands the close attention of the designing engineers.

As the plant capacity of a refinery is increased, provision must also be made for an increase in the supply of water to be delivered to the various departments and units.

Consequently, either in the design of water systems for new refineries or in enlarging the systems of old plants, refinery engineers and engineering departments are called upon to estimate accurately the loss of head due to friction in such water pipes in order to determine the exact operating conditions of the proposed water-pumping installation.

Usually, to make such estimates accurately has always been a problem of great difficulty to the refinery engineer. This difficulty has been due to the fact that the friction of a given length of pipe varies greatly with the surface of the pipe, number of bends, shape of fittings, and so forth. The friction in the pipe itself can be determined with reasonable accuracy, but the loss of head due to friction and shock in elbows is an unknown and uncertain quantity.

CALCULATING FRICTION HEAD

Parenthetically, it might here be mentioned that, in laying out water piping, great care should be used

TABLE 1

DATA FOR COEFFICIENT "c" FOR DIFFERENT KINDS AND SIZE OF PIPES AND VALUES OF "K" FOR DIFFERENT VALUES OF "c"

(Courtesy—DeLaval Steam Turbine Company)

Size of Pipe, inches			2 to 3													
c	K	Condition of Pipe	4	5	6	8	10	12	16	20	24	30	36	42	48	54	60
			Year of Service for Cast Iron Pipe														
140	.54	Very smooth and straight Brass, Tin, etc.	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
130	.615	Ordinary straight Brass or Tin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	.715	Smooth new Iron	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6
110	.84					10	10	10	11	11	11	12	12	12	12	12	12
100	1.0	Ordinary Iron	13	14	15	16	17	17	18	19	19	19	20	20	20	20	20
90	1.21							26	27	28	29	30	30	30	30	31	31
80	1.51	Old Iron	26	28	30	33	35	37	39	41	42	43	44	45	45	46	47
60	2.58	Very rough	45	50	55	62	68										
40	5.45	Badly tuberculated	75	87	95												

00 indicates the very best cast-iron pipe laid perfectly straight, and when new. 0 indicates good, new cast-iron pipe.

so as to avoid sudden changes in velocity or sudden changes in the direction of the rapidly moving stream. Also, it is quite necessary that proper attention be given to the velocity of the water through the pipe and fittings and that a velocity be selected consistent with length and character of the pipe and general arrangement of the installation.

In order to estimate the loss of head through friction in water piping, the chart that is given with this artcle may convenently be used.

If the water quantity passing through the pipe and the size of the pipe are known, the friction head in 1000-*feet length of pipe is found by laying a straight edge through the known points of the scales representing capacity and size of pipe. The friction head is then read off on the third scale at the point of intersection between the straight edge and this scale.*

The values of the chart are based upon the Haz-en-Williams formula:

$$v = cr^{0.63} \left(\frac{h}{l}\right)^{0.54} \times 10^{0.32}$$

Where,

"v" is the velocity in feet per second,

"r" is the hydraulic radius equals $\frac{\text{diameter}}{4}$ in feet,

"h" is the fraction head,

"1" is the length of pipeing, and

"c" is a constant depending upon the roughness of the pipe and the hydraulic radius.

This formula also can be written:

$$h \text{ equals } \frac{147.85}{c} \times \frac{Q}{d}^{2.63^{1.852}}$$

Where.

"h" is the friction head in feet,

"l" is the length of piping (1000 feet),

"Q" is the water quantity in gallons per minute, and

"d" is the diameter of the pipe in inches.

The chart shown herewith is based upon a value of "c" equals 100,

which figure is generally used and is considered safe for ordinary conditions.

For other values of "c", the figures obtained from the chart should be multiplied by

$$K \text{ equals } \frac{100}{c} 1.852.$$

Table 1, shown below, gives data regarding the coefficient "c" for different kinds and size of pipes, and also values of "K" for different values of "c"'.

As a general rule, a velocity of 6 to 8 feet per second in water piping should not be exceeded, in view of the fact that a higher velocity is apt to result in excessive friction loss.

When centrifugal pumps are used for pumping water seldom, if ever, should the pipeing be installed of the same size as that of the outlet or inlet of the pump. Centrifugal pumps, of nec-

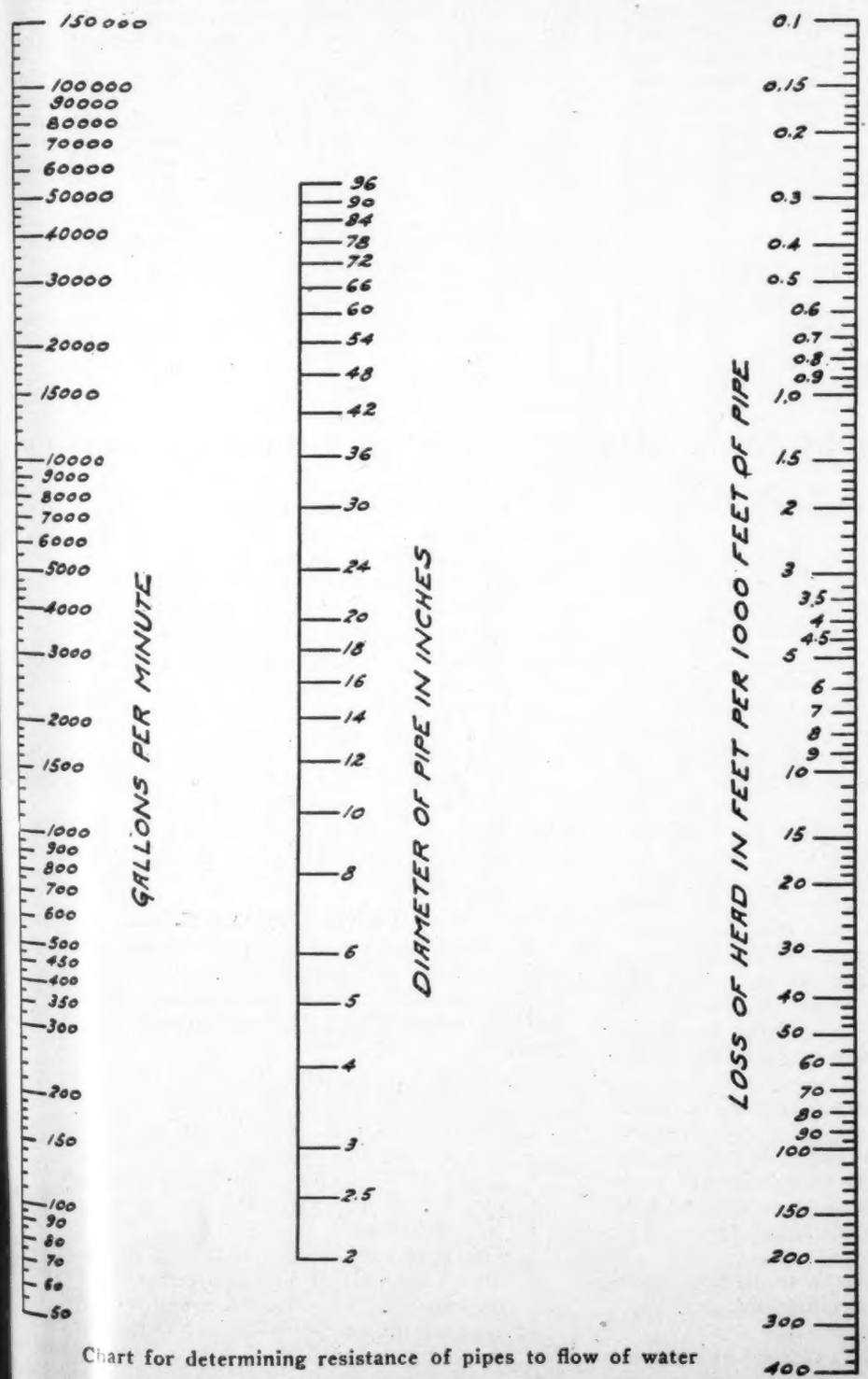


Chart for determining resistance of pipes to flow of water

Courtesy DeLaval Steam Turbine Company.

essity, must have a high velocity through the casing in order to obtain high efficiency. Consequently, the size of the opening of a properly-designed centrifugal pump is no indication whatsoever of the proper size of the piping to be attached to it. The only correct method of determining the pipe size is one that includes a careful analysis of the velocity of the water through the piping, length and character of the piping, number of fittings, bends, and so forth.

Table 2 gives data showing "pounds per square inch" equaled by "head in feet" for water at 62° F. weighing 62.364 pounds per cubic foot.

TABLE 2

POUNDS PER SQ. IN. TO HEAD IN FT.

(For Water at 62° F., weighing 62.364 lb. per cu. ft.)

(Courtesy DeLaval Steam Turbine Company)

Lbs. per Sq. In	Head in Feet	Lbs. per Sq. In.	Head in Feet	Lbs. per Sq. In.	Head in Feet	Lbs. per Sq. In.	Head in Feet
1	2.309	40	92.38	79	182.4	190	438.8
2	4.619	41	94.69	80	184.8	195	450.3
3	6.928	42	97.00	81	187.1	200	461.9
4	9.238	43	99.31	82	189.4	210	485.0
5	11.55	44	101.6	83	191.7	220	508.1
6	13.86	45	103.9	84	194.0	230	531.2
7	16.17	46	106.2	85	196.3	240	554.3
8	18.48	47	108.5	86	198.6	250	577.4
9	20.78	48	110.8	87	200.9	260	600.5
10	23.09	49	113.2	88	203.2	270	623.6
11	25.40	50	115.5	89	205.5	280	646.6
12	27.71	51	117.8	90	207.8	290	669.7
13	30.02	52	120.1	91	210.2	300	692.8
14	32.33	53	122.4	92	212.5	310	715.9
15	34.64	54	124.7	93	214.8	320	739.0
16	36.95	55	127.0	94	217.1	330	762.1
17	39.26	56	129.3	95	219.4	340	785.2
18	41.57	57	131,6	96	221.7	350	808.3
19	43.88	58	133.9	97	224.0	360	831.4
20	46.19	59	136.3	98	226.3	370	854.5
21	48.50	60	138.6	99	228.6	380	877.6
22	50.81	61	140.9	100	230.9	390	900.7
23	53.12	62	143.2	105	242.4	400	923.8
24	55.43	63	145.5	110	254.0	410	946.9
25	57.74	64	147.8	115	265.5	420	970.0
26	60.05	65	150.1	120	277.1	430	993.1
27	62.36	66	152.4	125	288.6	440	1016
28	64.66	67	154.7	130	300.2	450	1039
29	66.97	68	157.0	135	311.7	460	1062
30	69.28	69	159.3	140	323.3	470	1085
31	71.59	70	161.7	145	334.8	480	1108
32	73.90	71	163.0	150	346.4	490	1132
33	76.21	72	166.3	155	357.9	500	1155
34	78.52	73	168.6	160	369.5	600	1386
35	80.83	74	170.9	165	381.0	700	1617
36	83.14	75	173.2	170	392.6	800	1848
37	85.45	76	175.5	175	404.1	900	2079
38	87.76	77	177.8	180	415.7		
39	90.07	78	180.1	185	427.2		

Specifications for Suitable Mixing Tank for Contact Filtering

(*Continued from page* 68)

1. All dimensions to be true and in accordance with the purchaser's drawings.
2. The material to conform to the standard specifications for plates and rivets of the Association of American Steel Manufacturers.
3. All plates and heads to be open-hearth Class "A" steel.
4. All rivets to be open hearth Class "C" steel.
5. Girth joints to be single riveted lap joints—⅝-inch rivets, 1¾-inch pitch, 1⅛-inch gauge. Longitudinal joints to be double riveted lap joints—⅝-inch rivets, 2-7/16-inch pitch, 1½-inch pitch of rows, 1⅛-inch gauge. All other rivets to be of the size and pitch noted on the purchaser's drawings.
6. Rivet holes to be punched 3/16 of an inch less than the full diameter of the rivet, and then drilled or reamed to a finished diameter of not more than 1/16 of an inch larger than the rivet, with plates and heads bolted in position. After drilling or reaming the rivet holes, the plates and heads shall be separated and the burrs removed. Rivets shall be of sufficient length to fill rivet holes completely and to form heads equal in strength to the bodies of the rivets.
7. All caulking edges to be beveled, sheared or planed for caulking. Caulking to be done with a round-nosed tool. The joints to be made oil and gas tight by caulking only. No foreign matter to be used in the joints. The shell to be caulked both inside and outside. No caulking of rivets to be allowed.
8. The tank to be made absolutely oil-tight. (Ordinarily it will be tested by filling the tank with water.)
9. In the shop the metal shall be cleaned of dirt, rust and scale; and the outside surface shall be given a coat of graphite and oil. After being completed, caulked and tested the outside surfaces shall be given another coat of graphite and oil, well worked into joints and open spaces.
10. All workmanship to be first class. The plates shall be formed cold to exact requirements after punching and beveling. Drift pins shall be used only to bring the parts together. Drift pins should not be driven with enough force to deform the metal around the holes. Riveting shall draw the joints to a full and tight bearing.
11. The manufacturer shall submit a shop drawing to the purchaser for approval, and shall furnish all facilities for inspecting and testing.
12. Tank to be shipped assembled with flanges, stuffing boxes and coil in place; agitator, agitator drive and top cover to be shipped separately.

TANK INSULATION

To obtain heat economy it is essential that mixing tanks used in the contact filtration of oils should be properly insulated. A suitable insulating covering for a tank, such as has been described herein, consists of the following:

1. (Next to tank shell). Layer of 12-inch by 36-inch by 1½-inch (thick) 85 per cent. magnesia blocks.
2. One-fourth inch (first) coat of Johns-Manville No. 302 asbestos cement.
3. Layer of 1½-inch galvanized chicken wire.
4. One-fourth inch (second) coat of Johns-Manville No. 302 asbestos cement.
5. One-fourth inch finish coat of a mixture consisting of one part of Portland cement and two parts of Johns-Manville No. 302 asbestos cement.

In applying the magnesia blocks and the chicken wire, No. 14 galvanized soft, steel wire should be used for both vertical and circular ties—the latter being spaced nine inches apart. All joints should be "broken."

Indian Perfects Vacuum Process For Lubricant

INDIAN REFINING COMPANY, Lawrenceville, Illinois, announces that it is manufacturing and will soon begin shipment of its new low cold test paraffin base motor oil. Much interest has been evidenced in refining and marketing circles in the last few months in this company's perfection of its new process and the preparation of this improved lubricant.

Up to this time the company has withheld practically all information relative to both the process controlling the manufacture of its lubricants and detailed specifications of the oils. With the attainment of the desired oil characteristics and perfection of the process on a successful commercial scale, Colonel J. H. Graham, president, and Dr. Frank Fitts, executive vice president, in a recent interview granted the writer, were willing to discuss the process and the product.

Colonel Graham states that during the past four years the company has been carrying out exhaustive research experiments which were followed by the designing and construction of the company's two commercial units now in operation, and with all of the work, both chemical and physical, performed with the view of producing paraffin base motor lubricants possessing specifications and characteristics greatly different from most motor oils of the present time. The oil now being produced is paraffin base, having a cold test of 10 degrees below zero, and possessing the important qualities of "pumpability" by engine pumps, or fluidity at such low temperatures as 20 below zero. Since the oils are practically wax free, they possess very high heat resisting qualities, somewhat higher flash and fire points, and high resistance to emulsification. The removal of the wax also effects very low carbon residues (Conradson). With motor oil produced by the new process running 50 to 70 seconds viscosity at 210 degrees, the carbon residues are reported as "trace." Oil running from 90 to 120 seconds viscosity at 210 show carbon residues of approximately one-third to one-half of one per cent.

The details of technology of the process, the type or equipment used, and the engineering data having to do with details of construction and design of equipment, are not yet available. The process involves much that is new in refinery processing, petroleum physics and chemistry. It effects the removal of all of the light ends of the lubricating oil fractions, thus decreasing volatility of the finished product, and at the same time effects an increased yield of lubricating oil from the barrel of crude, and at lower operating cost than the company has ever secured following the established methods.

The process comes after exhaustive laboratory experiments, as well as much work on a commercial unit. This unit is in general characteristics of design and construction, totally different from any other refining equipment used in similar processing. In addition to a unique tube still design, for high vacuum distillation, the unit includes boilers of very high efficiency and low operating cost, that are a departure from any similar apparatus now in service in this industry.

Colonel Graham states that he has always been a believer in the theory that it is possible to remove the wax molecules from the lube distillate even though they may be held in an intricate solution with a varying number of the series of both paraffins and waxes—in which view he is supported by many of the industry's technologists. Research at the plant, at certain universities and elsewhere has proven to company executives the feasibility of complete separation of the wax series, and leaving behind only the paraffins totally wax free, if such is necessary. Whereas many refiners have believed that wax could not be entirely removed from the lubricating oil fractions, or at least not commercially or at sufficiently low cost, technologists at the Indian plant make claims based on their recent perfection of the new process, and offer conclusive evidence that they can remove all of the wax and prepare lubricants which are pure, or very nearly pure paraffin oil. The very low cold test, the lower fluidity, and the high heat resistance seem to bear this out.

Workers Make Good Records to Win National Safety Contest

AWARDS of beautiful bronze placques to winners in the Petroleum Section contest of the National Safety Council were recently announced. The contest began February 1 and ran for six months, awards being made to seven divisions of the oil industry on their safety records.

The Manufacturing Division trophy was won by the Bayonne Works of the Vacuum Oil Company with a frequency record of 2.63. This refinery employs an average of over 650 men. The Brunswick Pennsylvania, plant of the Atlantic Refining Company finished second with an accident frequency rate of 3.54. However, the frequency rate of the Bayonne, Paulsboro, Olean, and Rochester plants of the Vacuum Oil Company taken collectively was 4.16. The Brunswick plant of the Atlantic Refining Company is the only plant in the Manufacturing Division having a better record than that of the plants of the Vacuum Oil Company taken collectively.

The Natural Gasoline Division trophy was won by the Dawes-West Virginia Division of the Pure Oil Company with a no lost time record for 65 men. The Wentz Oil Division of Ponca City, Oklahoma, also went through the period of the contest without a lost time accident to their natural gasoline plant employees numbering about 35.

The Pipe Line Division trophy was won by the Midwest Refining Company of Midwest, Wyoming, with a record of no lost time accidents to their 100 pipe line employes.

The Marketing Division trophy was won by the Associated Oil Company of California by an accident frequency record of 10.20 covering the experience of over 1300 employees.

The Producing Division trophy was won by the Illinois Division of the Pure Oil Company, which had no lost time accidents during the six months of the contest. The Illinois Division employs about 70 men. The Midwest Refining Company employing over 800 men led in this division until the final month when the Midwest Refining Company experienced six lost time accidents.

Asphalts—Their Origin, Manufacture And Uses

By GEO. W. CUPIT, JR.
Chemical and Refining Engineer

This second and concluding part of Mr. Cupit's discussion on asphalts deals chiefly with manufacturing methods. Uses of asphalts are also included.

The first part was printed in the August, 1928, *issue of* THE REFINER AND NATURAL GASOLINE MANUFACTURER.

PART II

BEFORE entering the second part of this discussion the author believes a short summary of Part I will aid in maintaining the continuity of subject. In referring to petroleum asphalts, it should be remembered that from the standpoint of solid hydrocarbons present, petroleums are divide into three distinct groups:

1. Those bearing a substantial quantity of solid paraffines.
2. Those bearing a substantial proportion of asphaltic bodies.
3. Those of mixed composition, bearing both solid paraffine and asphaltic bodies.

The solid paraffines are generally associated with open chain hydrocarbons, while the asphaltic bodies are composed of cyclic hydrocarbons.

So complicated are the changes which take place in the oxidation of asphalts that it is almost impossible to say definitely which one of three takes place. By that I mean, whether it is straight oxidation, polymerization, or condensation. Results have been obtained indicating that it is first a process of oxidation followed by polymerization. Other results show that a normal condensation reaction took place in which case the resulting product differed from the polymerized product in all physical tests.

I shall not take the time to define the meanings of polymerization and condensation as that has already been done from a chemical standpoint in Part I. It should be remembered that the time factor for blowing asphalts and the temperature factor during same are of vital importance. These will be explained more fully later. Oxidation, polymerization, and condensation cause the hydrocarbons to form compounds of higher molecular weight and this tendency increases in the order named. Likewise the resultant products become more complex structurally. The use of steam plays such an important role in the manufacture of asphalts that I have discussed it under a separate topic in Part I. Therefore I refer you to that article.

In summarizing sulphurized asphalts it should be remembered that sulphur has the same condensing effect upon the hydrocarbons as oxygen has. This is brought about, of course, under the action of heat. Sulphurized asphalts lack ductility but are comparable with other asphalts in the remaining physical tests.

By the term residual asphalts is meant those products which are obtained by steam distillation of mixed base or asphaltic base petroleums. In this respect it should be kept in mind that non-asphaltic petroleums are unsuitable for the manufacture of residual asphalts. At no time during the reduction should the temperature be allowed to exceed 800° F. If such be the case, however, excessive decomposition and cracking of the hydorcarbons will take place, thereby yielding an inferior product. This is especially liable to be the case if a residual asphalt of hard consistency and high fusing point is to be produced.

Some petroleums, such as Mexican, are very susceptible to overheating. Therefore, great care must be exercised not to allow the residuum in the still to exceed a temperature of 660° F. When asphalts (residual) were first manufactured in this country for commercial use difficulty was encountered in maintaining the desired temperature control. Consequently residual asphalts soon fell into disrepute. It was not long before this difficulty was overcome and today, residual asphalts are being marketed of excellent quality with a hardness approximating 100 (as determined on the consistometer), and a fusing point of 437° F. This is due to the better methods of control. It is a much harder proposition to produce a residual asphalt than a blown asphalt of a given high fusing point.

Various processes have been devised for removing undesirable constituents from residual asphalts, the crudes of which possess a mixed-base character. One, in particular, is worth mentioning at this time. A large quantity of low-pressure steam is super-heated to 700° F. and introduced through a charge of asphalt heated in the still to 600°-700° F. The originator of the process claims that the heavy paraffine-like hydrocarbons are non-ductile and non-adhesive in character, and in addition, impart undesirable characteristics to the asphaltic hydrocarbons when mixed with the latter. I refer to mixed base crudes as the starting point. The product obtained from the above method has exceptional ductility and possess a high degree of adhesiveness. In this respect the product differs from residual asphalts distilled with saturated steam, and likewise differs from blown asphalts prepared in the usual manner.

DETECTION OF CARELESSLY PREPARED RESIDUAL ASPHALTS

In this respect I should like to refer to several points which are of particular interest in proving a residual asphalt. If in the distillation of an asphalt, something has entered in to cause the final product to be off test, it is of vital importance to the stillman to know the reason. The following points are discussed to aid in coming to some definite an correct conclusion:

1. If the product lacks homogeneity it may be due

either to overheating in the still, or because the distillation has been continued too far.

2. The percentage of a large amount of non-mineral matter insoluble in CS^2 is due to overheating. Carefully prepared residual asphalts should not contain more than 5%.
3. The presence of too large a percentage of volatile matter may be due to not carrying the distillation far enough or running at a temperature insufficiently high to remove the low-boiling point constituents. This will also cause the product to have a too low flash point.
4. If the product has a greasy appearance on aging, it is due to the crude petroleum containing too large a proportion of paraffine-like hydrocarbons which were not removed during distillation. Crudes of this nature should be avoided.
5. The presence of carbenes shows that there has been overheating during distillation. Residual asphalts, carefully prepared, will not show more than 2.0% carbenes.

It is a well-established fact that residual asphalts made from mixed-base petroleum are not as susceptible to overheating as those produced from purely asphaltic petroleum. The amount of residual asphalt formed during distillation process is proportionately less for purely asphaltic petroleum than in the case of mixed-base petroleum. The asphalt residuum in the former instance will not show a greasy surface, regardless of how it may have been run.

CHARACTERISTICS OF RESIDUAL ASPHALTS

1. They posses a comparatively high specific gravity.
2. They possess greater hardness at 77° F. for a given fusing point.
   This distinguishes them from Blown Asphalts.
3. They show a negative diazo reaction. This also aids in distinguishing them from pitches derived from lignite, coal, shale, peat, etc.
4. The volatile matter, which for a given fusing point, is higher than that contained in the crude native asphalts.
5. The fixed carbon content is higher for a given fusing point than that of blown asphalt.
6. The absence of the anthraquinone reaction which distinguishes residual asphalts from the various pitches derived from coal.
7. The percentage of saturated hydrocarbons in residual asphalts will be greater than 25% whereas they will be less than this figure in the case of native asphalts.
8. Carbenes, when present in excess of 5% serve to distinguish them from native asphalts.
9. Residual asphalts may be distinguished from native asphalts by the low percentage of mineral matter which they contain, on an average 1% or less.
10. The tensile strength at 77° F. for a given fusing point, is greater than that of blow asphalts.

On account of their similar properties, it is impossible to distinguish between blown asphalts and residuals with accuracy. For comparison, let us note the differences with regard to percentages sulphur and saturated hydrocarbons contained in residual asphalts made from typical petroleums. By typical petroleums is meant Texas, California and Mexican. These three constitute nearly the entire source from which our residual asphalts are made today.

Residual asphalts obtained from Texas mixed-base petroleums are characterized by the presence of paraffine. They contain for the most part less than 1.5 per cent. sulphur, and range between 40-70 per cent. of saturated hydrocarbons. Those obtained from California asphaltic petroleums are practically free from paraffine, also contain less than 1.5 per cent. of sulphur, and show the presence of 25-40 per cent. saturated hydrocarbons. The asphalts derived from mixed-base Mexican crude petroleums contain small quantities of paraffine, four to eight per cent. sulphur and 30 to 50 per cent. saturated hydrocarbons. Many Mexican crudes are purely asphaltic in character. In distilling Mexican petroleum, it is necessary to use a large quantity of steam to drive off as much sulphur as possible, and to increase the ductility of the residual asphalt. Sulphur has a great affinity for certain organic hydrocarbons. This is particularly noticed in the distillates obtained when running to asphalt residuum. It is worth mentioning here that residual asphalts obtained from Trinidad asphaltic petroleums are free from paraffine, contain more than 1.5 per cent. sulphur and show 25 to 35 per cent. of saturated hydrocarbons.

RESISTING PROPERTIES OF RESIDUAL ASPHALTS

The resisting properties of residual asphalts vary depending upon the following conditions:

1. The crude petroleum from which the asphalt residuums were derived.
2. The extent to which the reduction has been carried.
3. The care with which the reduction has been performed.

Under the heading of number one, asphaltic petroleum produces the most weather-resisting residues, mixed-base petroleums come next, and non-asphaltic petroleums produce residuals having the least weather resistance.

Referring to number two, soft grades of residual asphalts carrying a large percentage of oily constituents, will stand the weather better than those from which the oily constituents have been removed by driving the distillation to a point where a hard and brittle residual asphalt remains.

Regarding number three, if the residue is badly decomposed or cracked, as evidenced by the presence of carbenes or free carbon, its weather-resisting properties will suffer proportionately.

In general, residual asphalts of the highest quality are inferior in weather-resisting properties to native asphalts, and blown asphalts. The comparison was made on respective products possessing the same volatility and fusing point. However, they are superior to corresponding sludge asphalts.

MEXICAN CRUDES RUN FOR PENETRATION ASPHALTS

Preparation for Charging—The still, brickwork, pipework and worms are inspected, and steam coils tested out to make sure there is no blockage. Then the blanks in charging, steam line and worms are taken out. Top and side manheads are put on and four or five spokes of top steam induced for 12 to 25 minutes. Still is now ready for charging.

Charging—Pumper opens valve on charging line and still is charged to specified outage, which is measured by means of a charging stick at 5 to 10 minute intervals

at small hole in manhead near charging valve provided for that purpose.

Firing—Still is lit up when same is finished charging. It is fired full until it reaches 170 F. or thereabouts, at which time if charge has moisture there will be signs of pressure at safety valve. At this point fires are checked and still allowed to subside until moisture is off, at which time a small stream will be running in light worm, and safety valve will be showing no pressure. Full blast is then put on fire until it reaches 350° F. Bottom steam is now started into still gradually, according to amount of steam which still will stand. Temperature of still is then raised 25 or 30° per hour. When still reaches 475 to 500° it has practically two valves of steam. Depending on grade of asphalt still will be 560 to 650° temperature when finished.

The following cuts are made:

Light Worm

Over to 32 Grav.	Unfit Gas Oil
32 to 26	Test Mexican Gas Oil
26 to Off	Unfit Gas Oil

Heavy Worm

Over to when Worm clears up	Unfit Gas Oil
When clears up to 26 Gravity	Test Mexican Gas Oil
26° Gravity to Off	Unfit Gas Oil

The bottoms are run to the desired penetration. The following table contains the standard grades of penetration asphalts produced from Mexican crudes.

The same procedure is followed in the processing of the following grades:

Name—	Start Testing Samples			Pumped to Storage Tanks	
325 Pen. Asphalt	Heavy	Worm	26	Grav.	325 Penetration
12 Flux (140/190 Pen.)	"	"	24/25	"	150/165 Pene
85/100 Penetration	"	"	22	"	85/100 "
60/70 "	"	"	21	"	60/70 "
50/60 "	"	"	20.5	"	50/60 "
40/50 "	"	"	20	"	40/50 "
38/43 "	"	"	19.5	"	38/43 "

(These samples are tested at 1 to 2 hour intervals, depending on what time still is making.)

Note: *Penetration.* When sample is taken to testing room, it is poured into a 3-ounce can and allowed to set at room temperature for 30 minutes. It is then put in bath which is kept at 77 degrees F. and tried for peneration with penetrometer.

Pumping out Still—When still is finished, bottom steam is taken out and enough top steam put in to kill existing gases. Safety valve is raised and finished asphalt is pumped through cooler at temperature of 500 or below to storage tank.

Stripping and Cleaning Still—After still has been pumped out all cocks are closed and tar plug on still put down. A full valve of top steam, as well as 2 or 3 spokes of bottom steam is put in still for 2 or 3 hours, depending on temperature of still. Lines are then blanked, top and side manheads taken off, and steam taken out. (Steam is kept in still until after manheads are taken out to avoid flashes.)

It is an understood fact that asphalt stills are not cleaned after each run, but may make from 15 to 20 runs before hot spots appear on bottoms, which indicate that still should be cleaned.

SLUDGE ASPHALTS

This class of asphalts is so-called on account of being produced from acid sludge. The acid sludge is obtained by treating distillates and reduced oils with sulphuric acid (H_2SO_4) either of 93.5 or 98 per cent H_2SO_4 content, agitating the oil and acid by means of air. The sludge formed is drawn either by gravity or pumped into a sludge cooking kettle. The procedure from thence is as follows:

Operation in the Cooking Kettle—Unfit gas oil (unfit as pressure still charging stock) having a gravity of 24-28 Be. is charged into the kettle to the extent of approximately one-third of the volume of acid sludge to be treated. An equal volume of water is added and the contents brought to approximately 190 degrees F. with open live steam. This procedure should have been done prior to adding the acid sludge. With the steam on, remove the sludge from the agitator and allow to steam 6-8 hours. At the end of this time the sludge, oil, and water will have broken into three layers, namely, acid oil or acid tar on the top, acid coke in the middle, and spent acid on the bottom.

In this condition the contents are allowed to settle approximately 14-16 hours to insure complete separation. It is not difficult to understand why this length of time for settling is recommended, when it is learned that 720 barrels of acid sludge were treated at one time.

After complete separation has taken place, determined by testing the pet cocks on the kettle from top to bottom, the acid oil is pumped from the top of the kettle into a storage tank. The spent acid, having a gravity of from 35-40 degrees, is drawn off into an acid pit and thence pumped to a weak acid storage tank through lead lines.

To the acid choke which remains in the kettle 300 barrels of hot water are added and again steamed for 4-5 hours and allowed to settle 2-3 hours. At the conclusion of this steaming, only two layers are formed, acid coke on top and weak acid (28-30 degrees gravity) on the bottom. The spent acid is run off by gravity into an acid pit and pumped from thence to weak acid storage tanks.

To the acid coke is added approximately 100 barrels of spent soda ash solution (from a previous treat) and the contents steamed for one hour. This is done to neutralize the remaining acid in the coke, thereby cutting down appreciably the amount of strong soda ash necessary to completely neutralize the acid coke. After an hour's cooking, allow to settle one hour and draw off the salt-acid solution to the sewer.

To the acid coke is added approximately 120 barrels of 33 degree gravity soda ash solution and live steam for one hour. The contents of the kettle will be very viscous. To take care of this the acid oil pumped off the top of the kettle on first separation is pumped back to the kettle and the contents steamed one hour longer. Two hundred barrels of hot water are now added, and the contents steamed 6-8 hours and allowed to settle 8-10 hours.

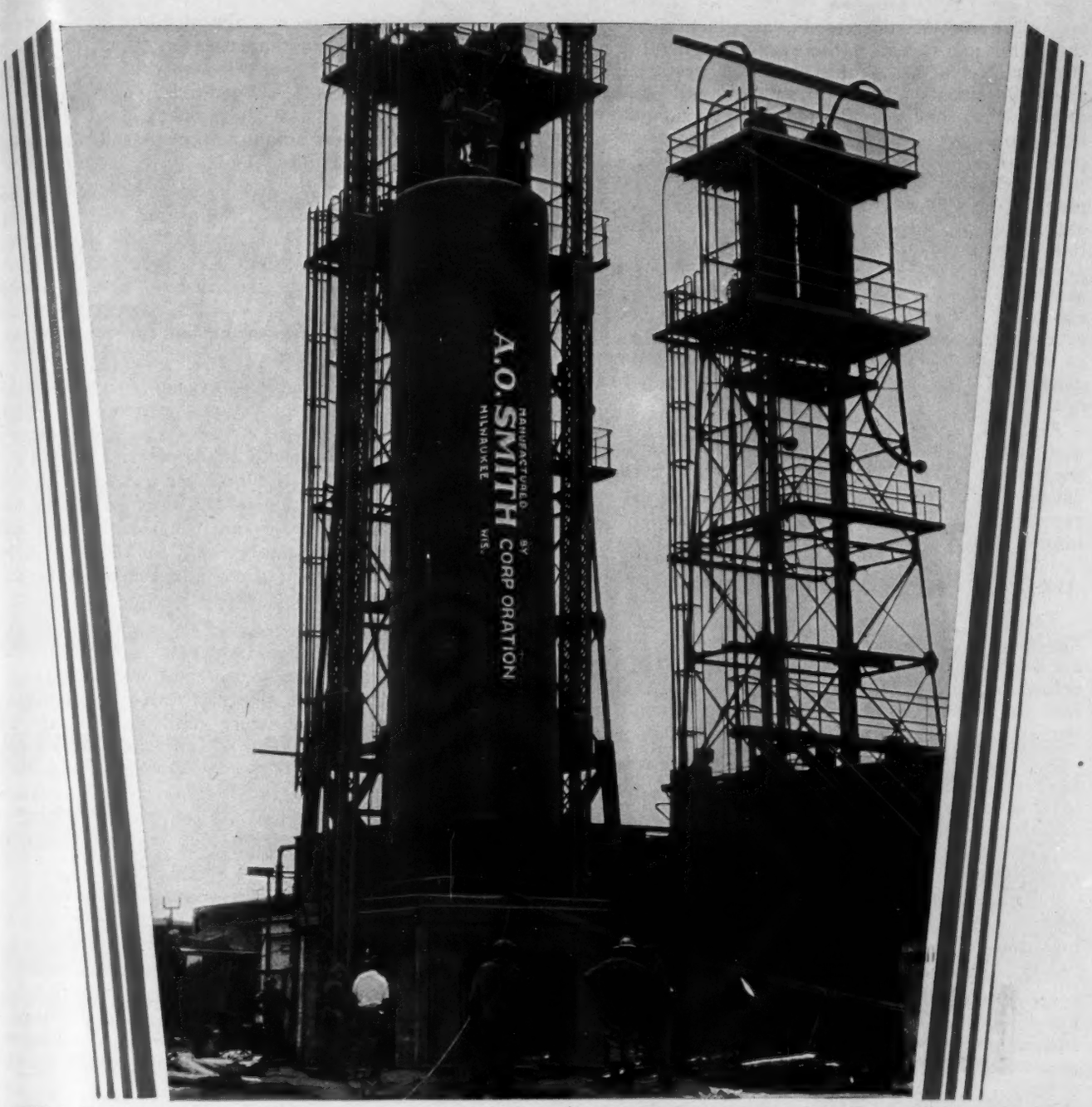
The kettle contains at this stage asphalt stock (on top) and spent soda solution (on bottom). The spent soda ash solution is pumped to a storage tank and held for another treat. The asphalt stock is retained for further still reduction and oxidation to desired asphalt products.

REDUCTION BY FIRE AND STEAM

Preparation for Charging—The pipework, still charging lines and worms should be inspected and steam coils tested to make sure there is no blockage. The side and top manheads are put on and top steam induced for 15 minutes.

Charging—The charging line is opened and still is charged to the specified outage determined by pet cocks at the rear end of the still.

Firing—When charged, the fires are started at full capacity until the temperature of the still has reached



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approximately 195 degrees F., at which time, if the charge has moisture in it, there will be signs of pressure at the safety valve. At this point the fires are checked and still contents allowed to subside until moisture is off, at which time a small stream will be running in the light worm, and the safety valve will be showing no pressure. Full blast is then put on fires until the temperature of the still reaches 350 degrees F. At this temperature bottom steam is started gradually into the still, increasing just as fast as the still will take it. From this point the still temperature is increased 25 degrees per hour, until 425-430 degrees F. has been reached. A sample of the still should be taken and tested for melting point. If the test shows approximately 90-95 degrees M.P. the reduction should be watched carefully, as 100 M.P. is that desired on the bottoms. When the desired M.P. has been reached the still is ready to pump out.

Pumping out Still—When still is finished, bottom steam is taken out and enough top steam put in to kill the existing gases. The safety valve is raised and the finished asphalt is pumped through a cooler at an approximate temperature of 500 degrees F., or below, into an oxidizer.

OXIDATION TO DESIRED MELTING POINT

There are various types of oxidizers now in service throughout the oil refineries. Those that are used most are the horizontal and vertical still type oxidizers. Some refineries have converted an ordinary horizontal still into an oxidizer by making necessary changes in the burners, air line distribution, heating surface, etc.

The type of oxidizer which has given the most satisfactory results is the vertical beehive type. The name is self-descriptive. The features regarding this oxidizer are: large heating area, capacity for handling large amounts of oxidizable products, heat distribution and control.

In order that as little heat as possible may be lost in pumping from the still to the oxidizer, the oxidizer is built a short distance from the rear of the still.

After the oxidizer is charged, the temperature of the contents is noted. If the temperature has dropped below 450 degrees F. (depending on the distance between still and oxidizer, weather conditions, and heat transmission coefficient) it should be raised to 450-475 degrees F., at which time top steam is added gradually, and in small quantity at first, increasing same until a full valve has been fed to the oxidizer by the time the still temperature has reached 520 degrees F. At this point the fire should be checked and the air induced through the spider or steam coil until the temperature has been raised by the air to 550-560 degrees F. and kept there. At 560 degrees F. hourly samples should be tested for melting point desired.

Various melting point products made by this process from acid sludge from treated reduced crude gave the following tests:

Melting Point	No. 130 M.P	No. 180 M.P.	No. 220 M.P.
B & R	130	180	220
H & C	147	193	244
Spec. Grav. at 60° F.	1.0153	1.0128	1.0013
Flash O.C.	570	570	570
Fire O.C.	650	630	625
Fixed Carbon	14.42	17.42	20.08
Ash	.08%	.14%	.25%
S.D.	1.08%	1.20%	1.27%
Sol. in CS,	99.72	99.80	99.86
Sol. in CC14	99.72	99.84	99.88
Insol. in 86° Naph.	17.11	20.79	40.90
Ductility at 77	110	2	
Penetration 100-5-77	40	12	4
" 100-5-32	4	1	
" 50-5-111	251	18	2

The evaporation loss was almost nil on each of these products. By studying the tests on these products it is readily seen that they are of a superior quality; high in melting point, low in evaporation, reasonably low in sulphur content, possess exceptionally good flash and fire points, and show a high percentage solubility in the inert solvents (CS2 and CC14.)

When especially high melting point products are desired having high flash and fire points, these products, which are, as a rule, made into fuel and burned, may be recovered and sold as such. At present such products would, no doubt, be classified as "Special Asphalt Products," although in one or two instances they have been used straight or compounded for practical purposes.

Another asphalt product obtained from acid sludge and which has found its way not only into the asphalt business, but into the paint business, too, is one made from acid oil, (sometimes called acid tar). Acid oil, it will be remembered, is the top layer formed on cooking acid sludge. After complete separation of cooked acid sludge has taken place, by sufficient settling, the acid oil is pumped directly into the still for reduction to desired M.P. The method of charging the still is the same as that already mentioned above.

After the still is charged, (1200 barrels) it is fired at full blast until the temperature reaches 450 degrees F. At this temperature approximately 4 or 5 spokes of the top steam are added and a half valve of air induced through steam coil, gradually, until the full valve has been added. At 500 degrees F. the fires are checked. The air, however, is continued and the temperature is raised by air oxidation to 530-550 degrees F. and kept there. When the temperature has reached 530 degrees F. samples are taken and tested every two hours for melting point.

When the melting point has reached 210 degrees F. the air is taken out of the still and the top steam induced, the reason for which is obvious.

The product formed by this process will be very smooth, glossy, and brittle. The latter characteristic allows it to be easily pulverized, and in this state it serves as an excellent pigment for paints. Its glossy characteristic serves to give the paint a smooth and even surfacing.

It has been found by experience in processing this product that the temperature should not exceed 550 degrees F., and the pumping out temperature should not exceed 450 degrees F.

While we are discussing the manufacture of asphalt by-products from the recovery of various acid sludges it would be a matter of neglect not to mention those by-products which may be made from sludges formed by acid treating distillates. It has been found that the best final products are obtained when acid sludges from both paraffine and naphthenic base oil distillates are mixed in various proportions. These proportions have already been determined, depending on the physical tests of the products desired.

The process for working up the acid sludge is precisely the same as that discussed in acid sludge recovery from treated reduced crudes. After complete separation of the acid sludge has taken place the acid oil is pumped off the top, the spent acid is drawn from the bottom of the kettle by gravity and that which remains in the kettle

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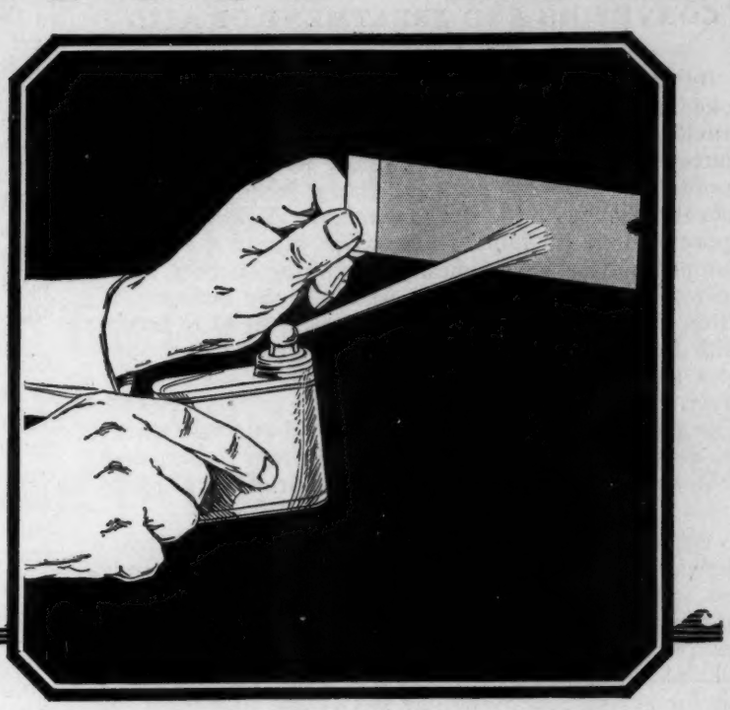

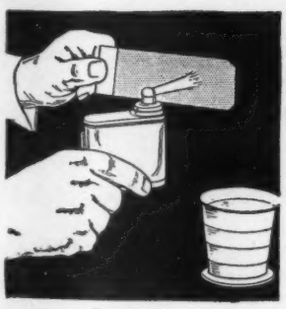

Figure 1

Here is a sheet of black iron coated with L & S Portland Cement Paint and made almost red hot with an alcohol flame. In spite of the terrific heat, the paint does not blister in the slightest degree. No better demonstration could be made to prove toughness and quality.

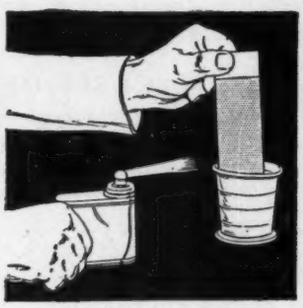

Figure 2

To further test the quality of L & S Portland Cement Paint, the sheet of black iron, while still hot, is immersed in cold water. This quick change from heat to cold has absolutely no effect upon the paint film.

Firgure 3

Demonstrating the extreme toughness of L & S Portland Cement Paint. Here it has been applied to ordinary galvanized iron sheet metal, untreated in any way before the application of the paint. Note that the metal has been bent double and yet there is no evidence of a crack or fracture in the film of paint.

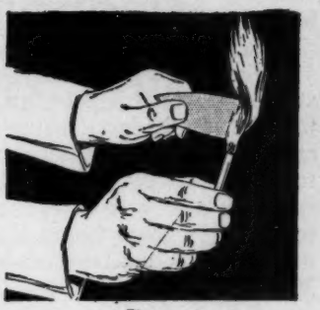

Figure 4

Burning an ordinary paper clip painted with L & S Portland Cement Paint to show the extraordinary character of the paint film. The paper is quickly consumed, but the paint film remains intact, often in large pieces.

L & S Portland Cement Paint contains Portland Cement combined with other pigments ground in treated oils. The result is a paint with a film so hard that it carries all the virtues of cement, yet retains a high degree of elasticity. L & S Portland Cement Paint produces a close-grained, flat finish of cement-like texture.

L & S Portland Cement Paint is a heavy bodied paint, but it has the easy working and brushing qualities common to high-grade oil paints.

L & S Portland Cement Paint dries flat, with a hard film that will not crack, chip or rub off. It has unusual tenacity and hiding power.

When applied to wood surfaces—wood bridges and trestles, shingle roofs, mine timbers—surfaces that come in contact with electric wiring, etc., L & S Portland Cement Paint greatly reduces the fire hazard.

The extent to which L & S Portland Cement Paint prevents the ignition of wood and other combustible building materials is truly remarkable, and this fire resistance is gained without sacrificing wearing or protective qualities as is often the case with other fire-retarding paints.

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is acid coke, or that layer in which we are particularly interested.

The processing of the acid coke layer from now on is quite different from the former method.

CONVEYING AND TREATMENT OF ACID COKE

By the aid of a screw conveyor and water, the acid coke, as it drops from the sludge kettle into a trough by gravity, is crushed into a somewhat granular paste and conveyed to a ground tank, where it is pumped into another cooking kettle. When a charge has been pumped into the cooking kettle the contents are allowed to settle approximately 45 minutes, at which time the water is pumped off the top by means of a swing suction. The acid coke, being the heavier, settles to the bottom. It often happens, however, that the water forms in layers with the acid coke, and if such be the case a few minutes air blowing will cause the water to assume one layer. In this condition the water is easily removed. The application of water has a two-fold purpose, namely, to remove the last traces of acid from the crushed coke as much as possible and to make it easier to pump from the ground tank into the cooking kettle.

When all water has been pumped off and the powdered coke is dry, 100 barrels of 33 degree gravity soda ash are added and the contents blown with air for approximately three hours. At this point an average sample is tested for alkalinity. If found to be slightly alkaline, approximately 400 barrels of unfit gas oil (unfit for pressure still charging stock) are added and the contents again blown with air approximately three hours.

After steaming three hours the contents are blown 45 minutes longer, followed by three to four hours' steaming. At this point an average sample is taken and tested for alkalinity, using Phenolphthalein as an indicator. As a rule, additional soda ash is required, due to the 500-barrel charge of acid coke. In case it is necessary to add more soda ash it will likewise be necessary to re-steam three hours longer. When a slight excess of soda ash has been added, determined by indicator, 200 barrels of hot water are added and the contents steamed approximately 20 hours. Avoid the addition of a large excess of soda. After cooking for this length of time the treat is finished up with approximately 500-600 barrels of hot water and steamed for one hour. Again the top layer is tested for a slight excess of alkali, using the same indicator as above. If test is satisfactory let settle five hours. At the end of this time draw off spent soda solution from bottom and pump the asphalt stock to a storage tank for further reduction. If asphalt products are not desired, this stock is used as fuel oil.

If oxidized asphalt products are desired the following procedure may be carried out:

After the still has been charged it is fired to a temperature of 450 degrees F., at which time top steam is admitted and air added through the bottom steam coils or spider, as the case may be. When the temperature of the still has reached 500 degrees F. the fires are checked and the air allowed to oxidize the asphalt until a temperature of 550 degrees F. has been reached. Samples for melting point determination are taken every half hour and when within 2-5 degrees of the desired melting point, the air is turned off and a slight increase in top steam is made.

When the desired melting point is obtained, everything is cut out of the still and the contents pumped to a storage tank. Asphalt products having melting points ranging from 120-150 degrees F. have been made on a plant scale with marked success, but products having higher melting points have not given very good results. The logical reason for this, no doubt, is due to a too vigorous oxidizing effect upon the by-product.

There are many refineries, now selling these products in the form of fuel oil, that could advantageously convert them into asphalt products and realize a bigger profit. At present the fuel oil problem is by no means a hard one to meet, mainly because the fuel oil supply is directly dependent upon the crude oil production. Crude oil production is now in excess of requirements.

The fact that the petroleum industry is beginning to realize the necessity for making those products from crude oil which will bring the largest profit and which will serve a far better purpose than that of burning, is sufficient to cause them to adopt new methods of refining to which they would ultimately have to turn.

CHARACTERISTICS OF SLUDGE ASPHALTS

These asphalt products are high in sulphur content. They contain a high percentage of oxygen, which distinguishes them from all other forms of asphalts, and constitutes one of the most dependable tests for identifying sludge asphalts. They contain a very limited amount of saturated hydrocarbons which serves to differentiate sludge asphalts from all other asphaltic products. The fact that the harder grades of these asphalts are very soluble in 88 degree Be. naphtha, distinguishes them from residual asphalts of the same hardness and fusing point. These products contain a high percentage of sulphonation residue. Of all the asphalts these products withstand the action of the weather the least. In practice, they are usually fluxed with other forms of petroleum asphalt, rather than marketed in their pure state.

USES OF ASPHALTS

The uses to which asphalts are put are so numerous that I shall not endeavor to name all of them—only the more important.

1. Roofing purposes. The melting point asphalts are used in this respect.
2. Building of roads. The penetration asphalts are here used. Fluxes are used with these asphalts to give a good binding quality.
3. Oxidized asphalts—used in the paint industry, and where hardness is desired. These products are used for fillers in a number of industries.

In conclusion; will say that a great deal of research work is being done to ascertain the composition and reactions that go on in the manufacture of asphalts. It should not be long before our petroleum chemists will lend a great deal of light upon this subject.

Pearl C. Higdon, 28, gauger for the Mid-Continent Petroleum Corporation, was fatally burned in a fire which destroyed the loading rack pump house of the company at West Tulsa. The fire followed a mysterious explosion; and Higdon, alone in the pump house when the blast occurred, was trapped by rapidly spreading flames. The fire corps maintained at the refinery prevented the blaze from spreading.

Wirt Franklin Oil Company, Ardmore, Oklahoma, is having preliminary plans prepared for construction of a 1000-barrel capacity refinery near Oklahoma City.

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A Visible-Action Continuous-Distillation Apparatus For Study of Fractionation

By RALPH H. ESPACH
Associate Refinery Engineer, U. S. Bureau of Mines

INTRODUCTION

THE value of careful fractionation in the manufacture of petroleum products is recognized more and more by petroleum refiners. Recent studies have shown that the quality of the products depends largely on the type of fractionating equipment and on the care used in operating the equipment. For example Rue[1] has shown that careful fractionation of pressure distillate will greatly reduce the amount of chemical treatment necessary to produce finished gasoline. The advantages of the combination of pipe still and bubble tower in obtaining good fractionation are well recognized in the petroleum industry. However, the equipment designed in the past has in general been much too large for convenient laboratory use.

The present paper describes a continuous-distillation apparatus for the laboratory study of fractionation. This apparatus has given very satisfactory results in the study of different crude oils and petroleum products. A discussion of the theory and action of bubble towers has not been given, as this subject has been discussed previously by Cooke and Rue[2]. It is believed that the distillation curves of the products obtained from this apparatus show clearly its capabilities.

[1]Rue, H. P., "Some effects of fractionation on the chemical treatment of gasoline"; The Ref. and Nat. Gas Manufac., vol. 7, No. 5, May, 1928, p. 96; Nat. Petrol. News, vol. 20, No. 17, April 25, 1928, p. 48; Oil and Gas Jour., vol. 26, No. 49, April 26, 1928, p. 142.

[2]Cooke, M. B. and Rue, H. P., Studies in the Fractional Distillation of Crude Petroleum: Tech. Paper 431, Bureau of Mines, 1928, in press.

GENERAL DESIGN

The design of the apparatus in general follows that of commercial installations of pipe stills and bubble towers. Special attention was given, however, to details of design and construction which would improve flexibility of operation, minimize corrosion, and facilitate observation of action within the apparatus. The pipe still, bubble tower, condenser, and coolers are all supported on a rigid frame built of 1½ and ½ inch pipe and supplied with water, gas, and electric and drain lines. The apparatus as arranged for one series of experiments is shown in Figure 1.

ACKNOWLEDGEMENTS

This investigation was conducted under the direction of the Bureau of Mines and under the general supervision of H. H. Hill, chief engineer, petroleum and natural gas division, in cooperation with the State of Oklahoma.

The writer is indebted to N. A. C. Smith, superinten-

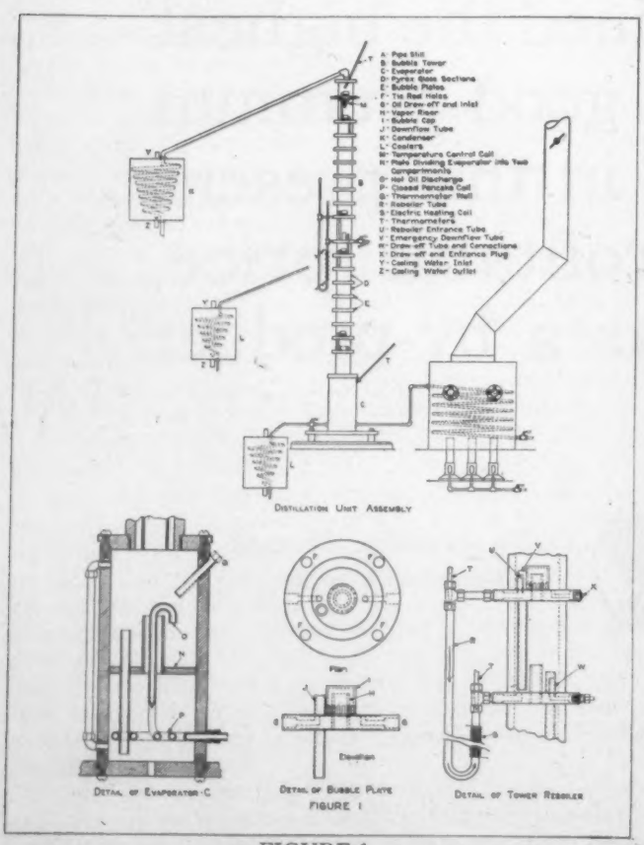
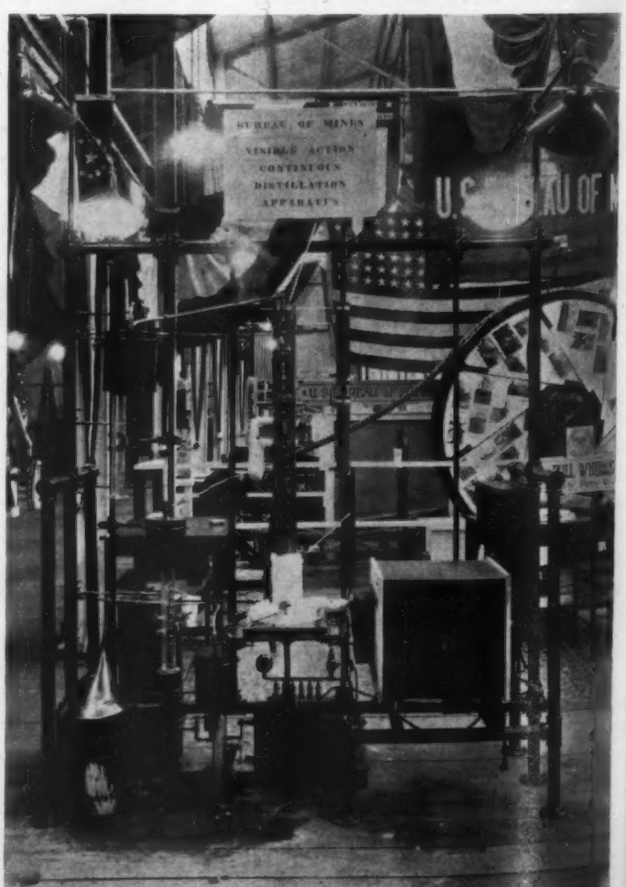


FIGURE 1.
And to the right, photograph of the apparatus displayed at Tulsa



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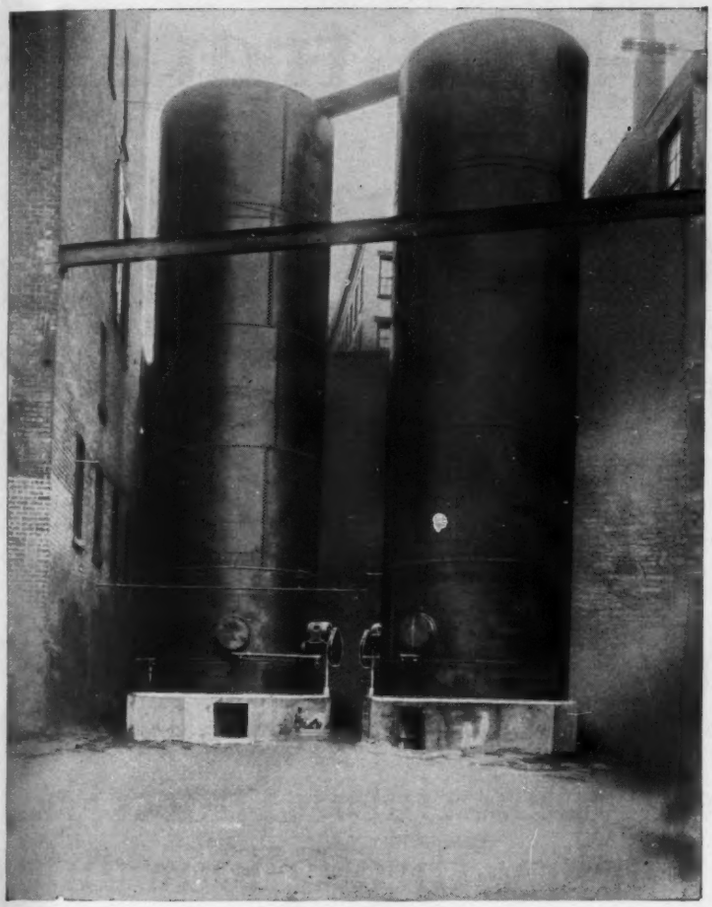

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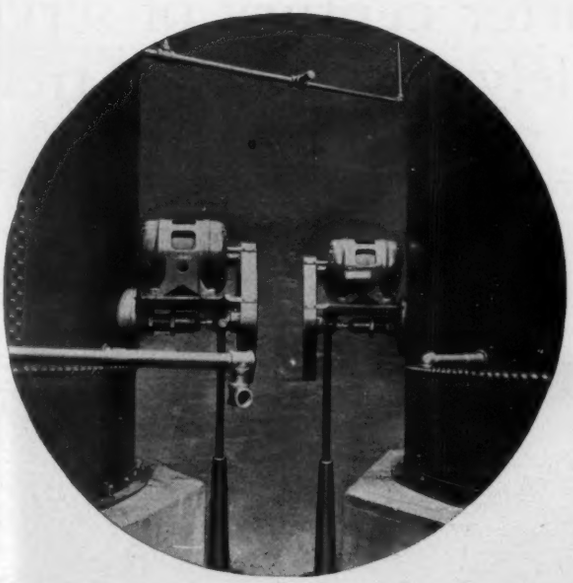

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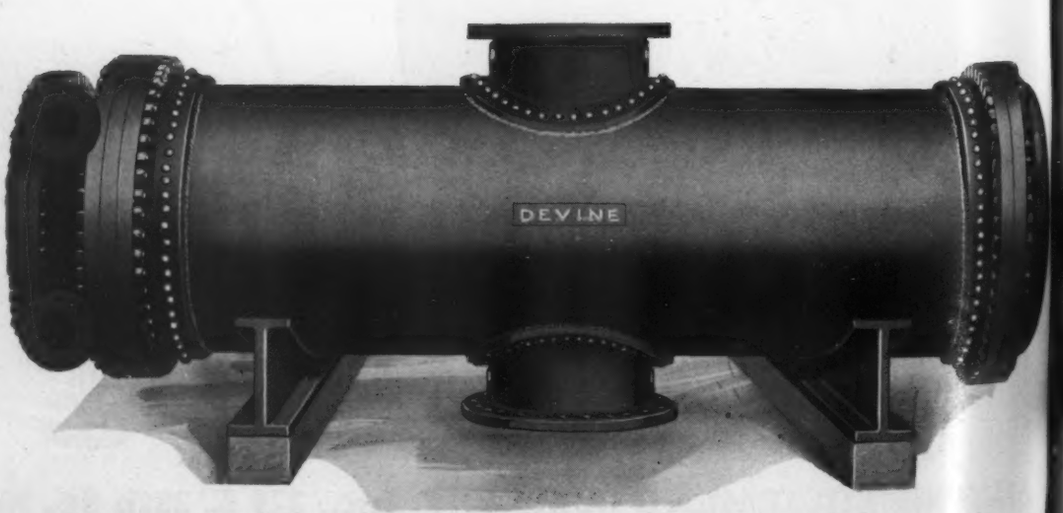

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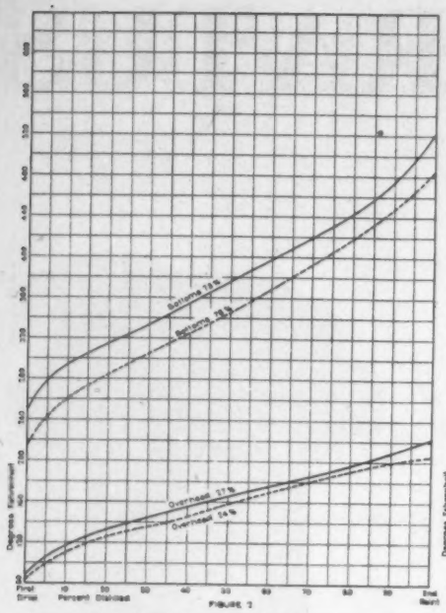
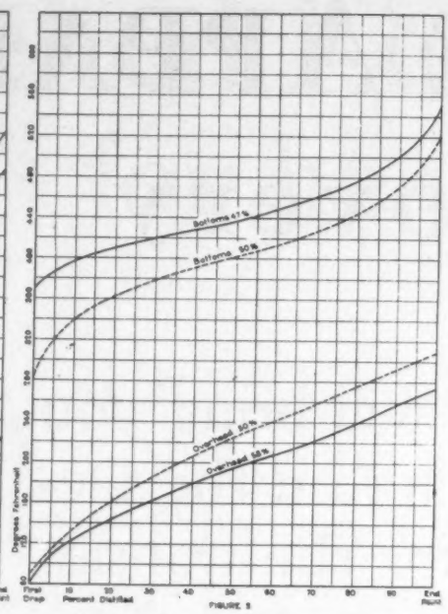
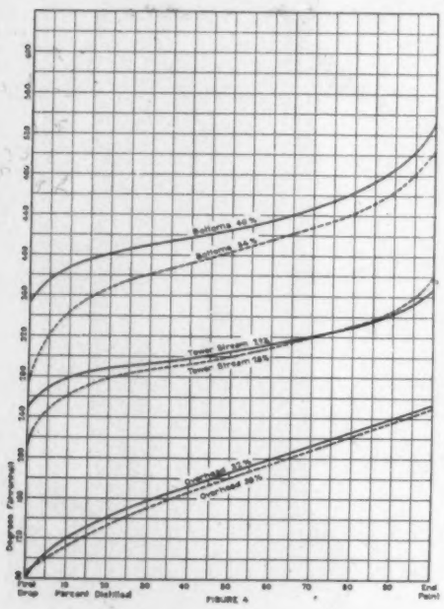
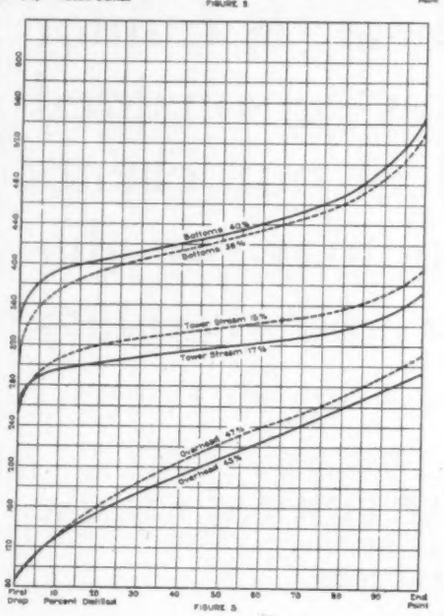








dent of the Petroleum Experiment Station, Bartlesville, Okla., for valuable comments and criticisms as the work progressed, and for reading the manuscript. Grateful acknowledgement is also made to H. P. Rue, associate refinery engineer, Petroleum Experiment Station, Bartlesville, Okla., for valuable suggestions on the design of the unit and its operation.

Arch L. Foster, associate petroleum chemist, constructively criticized the manuscript.

Grateful acknowledgement is made to M. H. Nolan, Producers and Refiners Corporation, West Tulsa, Okla., who furnished the pressure distillate for the experimental work; to H. A. Buss, foreman instrument maker, Petroleum Experiment Station, Bartlesville, Okla., by whom and under whose direction the pipe still, bubble tower, condenser, and coolers were made; and to other members of the Petroleum Experiment Station staff who assisted in the preparation of this report.

CONSTRUCTION OF PIPE STILL

The pipe still (A), Figure 1, as arranged for gas heating, is 15 by 12½ by 11¾ inches high and is divided into three parts: a combustion chamber, a tube chamber, and a flue. It is made of ¼-inch transite board bolted together and reinforced with small angle iron. An opening in the bottom of the combustion chamber allows the insertion of three Fisher burners. The bank of ⅛-inch tubes is inserted in to the tube chamber through a side opening which is closed by a small door made of transite. The stack breeching is fitted over an opening in the top of the flue. The inside surface of the furnace is thickly painted with water glass and covered with fiber asbestos. The water glass when dry cemented the fiber asbestos to the transite board, thus protecting it from the direct heat of the burners. The pipe coil is made of ten ⅛-inch pipe nipples 10 inches long and two ⅛-nich nipples 12 inches long connected by ells into a continuous coil. The coil has approximately one square foot of internal heating surface. The tubes are staggered to permit maximum contact with the hot gases passing downward over them. An electric muffle furnace of suitable design may be used instead of the gas-fired furnace to heat the pipe coil.

Construction of Bubble Tower

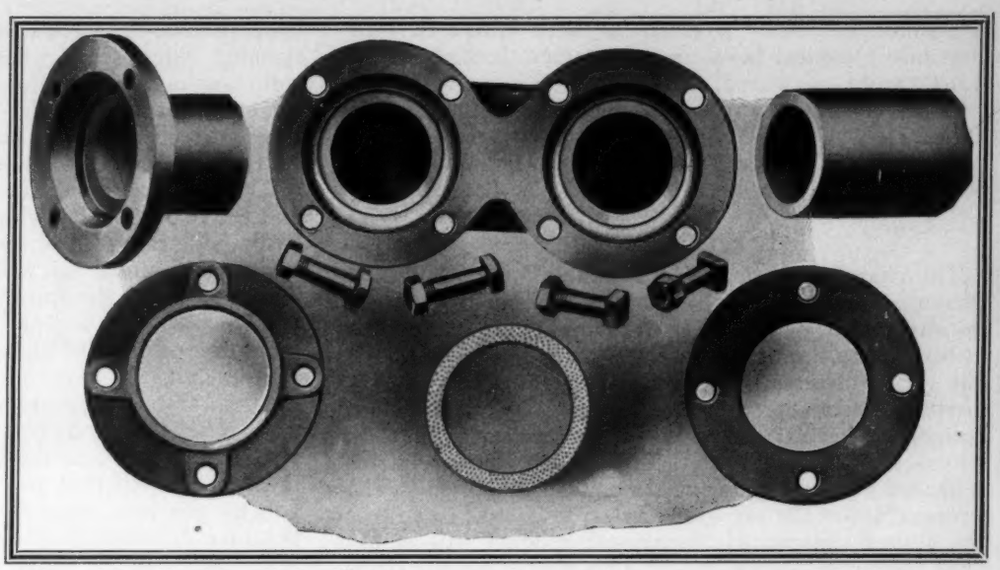
The tower (B) consists of stainless steel bubble plates separated by pyrex glass sections. The whole tower is supported on an evaporator (C). The glass sections, (D) are 2 inches outside diameter with ground ends to minimize leakage. The stainless steel plates (E) between the glass sections are ⅜-inch thick and are grooved 1/16 inch deep on each side to receive the ground edges of the glass sections; gaskets are inserted between glass and steel to insure a vapor-tight joint. The plates extend ⅛ inch beyond the glass walls to provide for holes (F). Tie rods pass through these holes and bolt the assembled sections together into one unit and make the tower rigid. Each plate is drilled to provide an oil draw-off and an oil inlet, (G). Downflow tubes (J) keep a ½-inch layer of condensate on each plate, causing the vapors to pass through at least ¼-inch of oil (the slots in the caps are ¼-inch high).

At the bottom of the tower is the evaporator into which the heated oil from the furnace is discharged, liberating vapors which pass up through the tower. This evaporator is 3 inches inside diameter and 7¾ inches high.

The tower is insulated by surrounding it with a brass jacket lined with ¼-inch of sheet asbestos. Windows are cut out of the jacket on two opposite sides, and are closed with sheets of clear mica, thus keeping a dead air space between the tower and the windows and yet permitting observation of the action in the tower. The evaporator and hot-oil transfer line are insulated with asbestos fiber.

CONSTRUCTION OF CONDENSER AND COOLERS

The condenser (K) consists of 8 feet of ½-inch out-



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side diameter Shelby steel tubing with 1/16-inch wall bent into a conical helix, in a container through which water can be circulated. The coolers (L) are similarly built but consist of 5 feet of ¼-inch Shelby tubing with 1/16-inch wall in appropriate water containers. Glass graduates are clamped under the outlets of the condenser and cooler coils to receive the distillates.

OPERATION

The charging stock is fed to the still under positive pressure, through a control valve. The hot gases from the burners passing over the pipe coil heat the oil, which in turn heats the evaporator and then the tower as the hot vapors ascend. The heat is regulated to obtain a predetermined percentage of "bottoms" (oil from the bottom of the evaporator). Too-great heat causes an excess of vapors to go up the tower; conversely, insufficient heat increases the percentage of bottoms. The temperature at the top of the tower is controlled so that the desired amount of "overhead" product will be obtained through the condenser. This temperature is regulated by circulating cool water through the temperature control coil (M), which causes a part of the vapors passing around the coil to condense and collect on the tower plates. The tower will operate better as a fractionator when some water is circulating through the coil, causing oil to reflux down the tower, than when the coil is not used. The "Tower stream," (condensate taken directly from a bubble plate), is regulated by control valves at the plate draw off.

The temperature differential between the evaporator and the overhead vapor may be varied over a comparatively wide range. The maximum differential is reached when the quantity of reflux condensate is nearly sufficient to flood the tower; the minimum, when no reflux occurs and the only heat loss is due to radiation from the tower. The charging rate may also vary widely, reaching a maximum when the tower is nearly flooded, and a minimum when the amount of heat carried by the oil vapor is insufficient to maintain the desired temperature in the tower. Experimental runs on the unit showed that any quantity between 0.4 and 0.8 gallons per hour may be satisfactorily handled. Temperature differentials have been as high as 275° F.

In each run the apparatus is adjusted until the desired quantities and temperatures are obtained and the bubble tower is operating smoothly and has come to equilibrium. Data on the operating conditions are recorded at 10 or 15 minute intervals. Samples of the various products are collected and tested for color, gravity, and distillation range. The distillation curves are plotted for study.

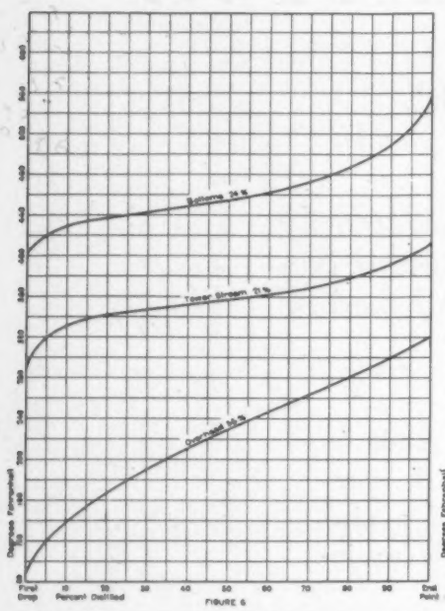

FIGURE 6

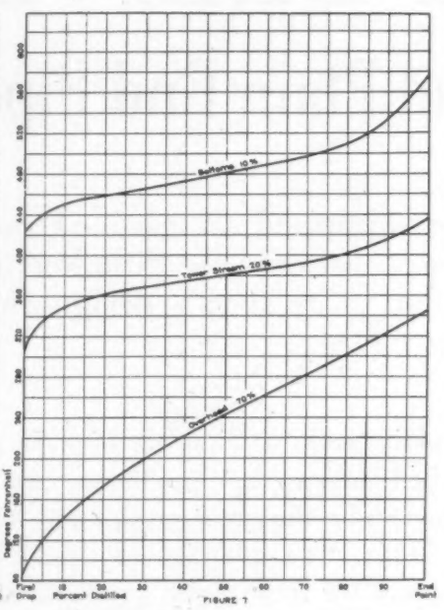

FIGURE 7

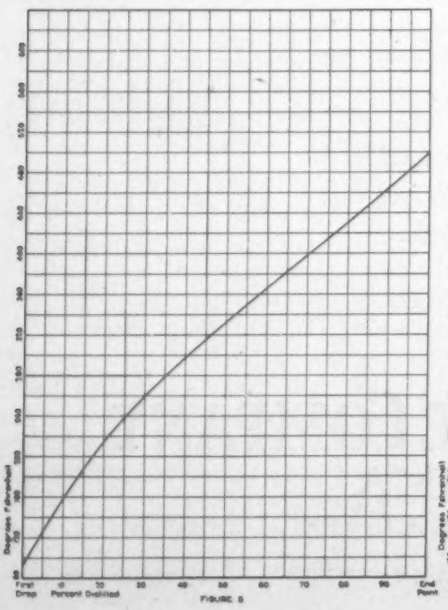

FIGURE 8

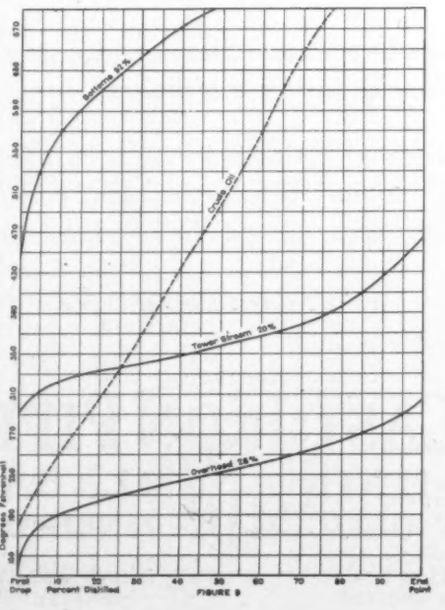

FIGURE 9

Effectiveness of Fractionation

The solid curves in Figures 2 to 5 show the distillation ranges of products made with the apparatus arranged as shown in Figure 1, and the dotted curves represent products made without using the "reboiler" at the side of the tower (see construction of reboilers, p. 5 and detail drawings, Fig. 1) and with a plain-type evaporator without reboiler coil and circulation equipment. The charging stock was a typical untreated pressure-still distillate (distillation curve, Fig. 8).

Discussing first the runs made without using the reboilers, the dotted curves in Figure 2 represent products made with a charging rate of 0.565 gallons per hour, yielding 76 per cent overhead distillate and 24 per cent bottoms. Figure 3 shows the distillation curves (dotted lines) when the unit was charging 0.758 gallons per hour and the yield was 50 per cent overhead distillate and 50 per cent bottoms. (Percentage figures are based on the total amount of distillate recovered in the receiver—not on the quantity of stock that was charged. The percentages do not take into account distillation losses which varied from 2 to 6 per cent of the charging stock). These curves indicate good separation of products, especially in Figure 2, which shows a gap of 9° F. between the end point of the over-

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head stream and the initial boiling point of the bottoms. In Figure 3 there is an overlap of 27° F. By referring to Figure 3 this overlap is shown to be equivalent to 3 per cent by volume of the bottoms.

The unit was then run, taking an oil cut or stream from the sixth bubble plate above the evaporator. The charge to the unit was 0.447 gallons per hour, which was separated into 38 per cent. overhead distillate, 28 per cent. tower stream, and 34 per cent. bottoms. The dotted curves in Figure 4 represent Engler distillations of these products and show excessive overlapping, especially of the bottoms and the tower streams. A similar run was made, taking the tower stream from the seventh bubble plate and increasing the charging rate to 0.683 gallons per hour; 47 per cent. overhead distillate, 15 per cent. tower stream, and 38 per cent. bottoms were obtained. The dotted curves (Fig. 5) also show excessive overlapping of products.

A study of these curves shows that the tower without reboilers is a satisfactory fractionator when separating the charge into only two products, but that the fractionation is rather poor when three products are obtained, and is of no value when more than three products are made. About 12 plates are required for good fractionation.

CONSTRUCTION OF REBOILERS

The reboiler in the evaporator is very simple in principle. (See detail of evaporator (C) Fig. 1.) The evaporator is divided into two compartments by a horizontal plate, (N); the hot oil from the furnace discharges into the upper compartment at (O), after passing through a closed coil (P) in the lower compartment. As the oil discharges into the upper compartment, vapors are liberated and pass upward through the tower. The remaining oil accumulates to a depth of 1½ inches in this compartment then flows down a tube into the bottom compartment where an oil level of 1½ inches is maintained by regulating the amount of oil drawn off as bottoms. The coil (P), mentioned above, is immersed in the bottoms collected in this lower compartment; the hot oil from the furnace, in passing through this coil, vaporizes the more volatile constituents in the bottoms. These vapors pass through a tube into the upper compartment and up into the tower.

The reboiler on the side of the tower in a U-shaped steel tube (R) (see detail of tower reboiler, Fig. 1). The oil flows through the reboiler and is heated by a small electric heating coil (S) of chromel wire, which is wrapped around the up-flow leg of the tube. By controlling the current with a rheostat the temperature of the oil passing through the tube may be regulated as desired. A small thermometer is placed where the oil leaves the upper plate and another at the entrance to the plate below. The chromel wire is covered with alundum cement, baked on, and the whole reboiler is covered with an asbestos fiber plaster. Two inches of the steel tube at the bend are left uncovered to avoid heating the other leg of the tube. If the tube should become heated on the downflow side of the reboiler, some light ends would distill off; these vapors would rise against the downward oil stream because of the relatively slow velocity of the oil through the tube, and would interfere with the flow of oil through the heater. The oil enters the reboiler through a vertical tube (U) with an open end ½-inch above the upper plate, which is connected with the reboiler, thus leaving ½ inch of oil on the plate.

Should the oil fail to pass through the reboiler, the oil level on the plate would build up until it reached ¾ inch; it would then flow down an emergency tube (V) similar to the others in the tower. The oil after being heated discharges into the "reboiler-section" of the tower. The plate in this section has a 15/16-inch riser but no bubble cap, so that the vapors rising in the tower pass through this section but do not bubble through the oil on the plate. The tower stream is taken from this plate through a vertical draw-off tube (W), the open end of which extends ½ inch above the plate. If no stream is being taken from the tower at this point, the oil level on the plate will increase to ¾ inch and then flow down a regular tube to the plate below.

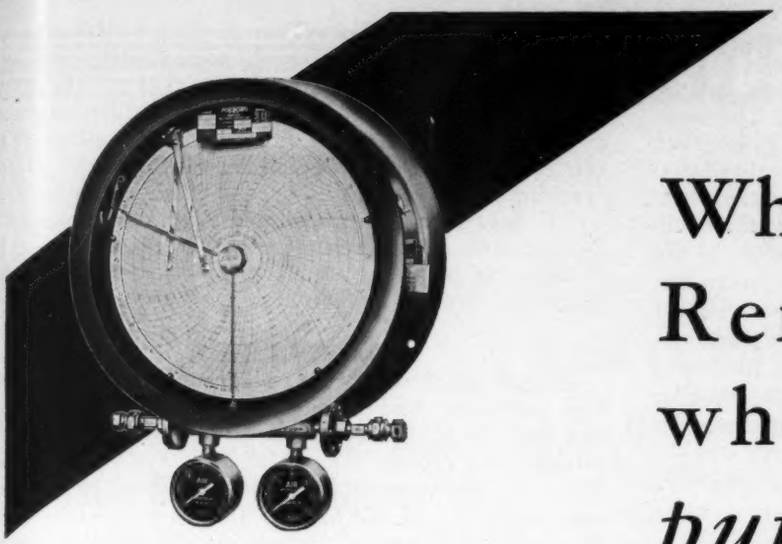
USE OF REBOILERS

The added effectiveness of the tower when "reboilers" are used to distill off the small amount of light ends remaining in the bottoms and the tower stream is shown by the solid curves in Figures 2 to 5. The charging rates and the percentages of distillate, tower stream, and bottoms are nearly the same in these runs as in the corresponding runs when the reboilers were not used. The temperature of the vapors in the evaporator is lower for the same percentage of bottoms, but the overhead vapor temperature of course is about the same. The reboiler at the side of the tower raised the temperature of the stream passing through it approvimately 50° F.

The distillation curves of the products obtained when charging 0.568 gallons per hour and obtaining 73 per cent. overhead instillate and 27 per cent. bottoms are shown by solid lines in Figure 2. The use of reboilers has increased the temperature gap between the end point of the distillate and the initial boiling point of the bottoms from 9 to 30° F. When charging 0.734 gallons per hour and obtaining 53 per cent. overhead distillate and 47 per cent. bottoms, products were obtained with distillation ranges as shown by the solid curves in Figure 3. The efficiency of fractionation under these conditions is surprising (a gap of 100° F.) but is believed to be within the capabilities of the tower. Part of the separation may be due to the nature of the charging stock, a cracked product composed in part of somewhat unstable hydrocarbons which under the influence of heat may polymerize or decompose. However, essentially the same amount of polymerization would occur in a corresponding run without the use of the reboilers; therefore, it is believed that the "gap" found is due mainly to good fractionation.

The results of running 0.436 gallons per hour and obtaining 32 per cent. overhead distillate, 28 per cent. off the tower, and 40 per cent. bottoms are shown in Figure 4. Figure 5 gives the results of the distillations on products obtained when charging 0.705 gallons per hour and obtaining 43 per cent. overhead distillate, 17 per cent. off the tower, and 40 per cent. bottoms. Comparing these curves with the dotted curves it is evident at once that excellent separation has been attained. The curves show clearly the effectiveness of the reboilers by the manner in which the extremities of the curves for "bottoms" and tower streams have been flattened. In Figure 4 there is an overlap of 5° F. between the end point of the overhead stream and the initial point of the tower stream representing less than 1 per cent. of the tower stream, and an overlap of 15° F. between the end point of the tower stream and the initial point of the bottoms representing less than 3 per cent. of the bottoms. Figure 5 shows an overlap of 31° F. between the overhead stream and the tower stream representing 7½ per cent. of the tower stream, and an overlap of 32° F. between the tower stream and the bottoms representing 3 per cent. of the bottoms.

Figures 6 and 7 are distillation curves of products ob-



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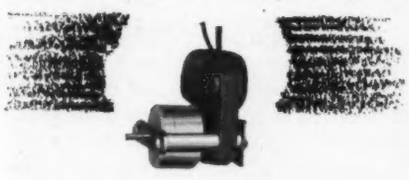

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tained on further runs with the unit. For those of Figure 6 the charging rate was 0.531 gallons per hour. Yields of 55 per cent. overhead distillate, 21 per cent. off the tower and 24 per cent. bottoms were obtained. The separation is good. For those of Figure 7, 0.486 gallons per hour were charged, obtaining 70 per cent. overhead distillate, 20 per cent. off the tower, and 10 per cent. bottoms. There is an overlap of 39° F. between the overhead an tower streams amounting to 8 per cent. of the tower stream, and an overlap of 13° F. between the tower and bottoms streams amounting to 3 per cent. of the bottoms. Although these comparatively narrow overlaps indicate fairly satisfactory fractionation, the lower end of the tower-stream curve shows that the reboiler did not remove all the light ends from this stream. Because approximately three-fourths of the charge was going overhead, this result is an indication that the reboiler was being worked beyond its capacity.

FRACTIONATION OF CRUDE PETROLEUM

The effectiveness of the tower in fractionating crude oil is shown in Figure 9. A sample of slightly weathered crude from the Tonkawa-Thomas field, Oklahoma, was charged at the rate of 0.650 gallons per hour, yielding 28 per cent overhead distillate, 20 per cent off the tower, and 52 per cent. bottoms. The Engler distillation curves of the products, with an Engler distillation curve of the crude (as far as it was possible to distill these without cracking) are shown in Figure 9. There is an overlap of 13° F. between the overhead and tower streams equal to 2½ per cent. of the tower stream, and an overlap of 18° F. between the tower stream and bottoms equal to less than 1 per cent of the bottoms.

CONCLUSION

Experimental work with this small tower indicates that very sharp and definite separations can be obtained, and that the reboilers are exceptionally effective, as one reboiler can replace 4 or 5 bubble trays. (In the first tower 12 trays were needed for efficient fractionation, whereas in the second tower 7 trays and a reboiler gave almost as good results). Many interesting problems are suggested by the experimental data already obtained, but much additional work must be done before these problems can be adequately discussed.

The Foreman As a Safety Man

By W. E. REARDON

General Superintendent, Columbian Gasoline Corporation

EVERYBODY pays a share in the cost of industrial accidents. The worker, the employer and the general public pay a part of the accident bill. The workman pays in loss of wages, for, although he is paid compensation, he loses a certain amount of wages. For injuries which disable him for less than a week, he usually receives no compensation other than having his doctor's bills paid. If an accident results in permanent total disability, the worker loses his earning power for life and thus pays dearly for his injury. If he suffers permanent partial disability—the loss of an arm, leg, finger, eye, or the loss of the function of any part of his body—his earning power may be impaired for life. He may have to seek a livelihood in some other line of work. It is impossible to estimate the possible loss which a workman thus sustains.

When the workman pays, his family also pays in the sacrifices which they must make. Poverty and sorrow result. Women often are forced to do hard work outside of the home to supplement the reduced wages which the disabled bread-winner is able to earn. The workmen pays in the pain and suffering which the injury causes him. And, too often, the workman pays for accidents with his life.

The company pays for accidents in many ways. In the first place, the company pays out money for compensation paid directly to the injured employee, or in the form of compensation insurance. The company suffers loss of production. Accidents cause idle machinery. When the regular operator is injured, a new man must be put in his place. Accidents break down morale in the working force. They put fear into the other workers. Accident costs must come out of the profit of the company. Competition forces the company to sell its products at the market price. Therefore, the company with a bad accident record is at a disadvantage in competition with companies who are keeping their accidents low.

CAN BE REDUCED

It is evident that everybody pays for industrial accidents. Everybody, in industry and out of industry, has a material as well as a moral interest in reducing accidents, and, while accidents can never be completely eliminated, the experience of successful companies is convincing proof that great reductions in their number and severity can be made. The opportunity for reducing accident costs and human suffering is a challenge to every worker, foreman and manager in industry.

In the causes of accidents lies the key to the reduction of accidents. Once we know the cause, there should be no stone left unturned until the cause is eliminated. The causes of accidents may be divided into three classes, mechanical hazards, physical condition of the worker, and the mental condition of the worker. By mechanical hazards we mean the dangers that go with the operating of boilers and machinery; the use of unsafe equipment and tools, rickety stairways, unsafe ladders, the danger from flying objects, slippery floors and walks, worn parts and guardless machines.

The worker's physical condition has a great deal to do with his liability to injury. Health and accidents bear a close relationship. Fatigue and accidents are also closely related.

The worker's mental condition means his attitude toward his job. Carelessness, recklessness, disobedience,

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ignorance and indifference are all the results of attitudes of mind. A fair share of our accidents is due to these mental conditions.

It is easier to provide safeguards to prevent accidents from mechanical equipment than it is to prevent accidents resulting from the physical and mental condition of the worker. Mechanical equipment can often be guardad so that it is practically "fool proof." Once the equipment is guarded, it is the duty of the foreman to see that guards are not removed from their proper places. If safety appliances are installed, great care should be taken to make sure that they do not interfer with the productive efficiency of the operator, for this is apt to cause the removal of the guard. Moving machine parts, transmission apparatus, exposed gears, floor openings, platforms, power lines, cellars, shafts, stairs, revolving setscrews, projecting bolts, clutches and couplings are all possible danger points. Ladders cause a good many accidents. Rickety ladders injure hundreds of men every year. It is true that most ladder accidents occur as a result of the carelessness of the worker. The foreman should take it upon himself to see that ladders are kept in repair and that workers are properly instructed in their use. There is no more sensitive nor delicate part of the anatomy than the eye. Foremen should insist that their men wear goggles on every job where any eye dangers exist.

HEALTH

The man in bad health is a great accident risk. His physical condition takes his mind from his task and while his mind if off the job, accidents may occur. The man with poor eyesight, or poor hearing is a very definite accident risk. Such a man is handicapped in seeing or hearing approaching danger.

Fatigue, the tired-out-feeling experienced as the result of work, is not entirely under the foreman's control. The greatest single cause for fatigue is the care which the worker takes of himself particularly during his hours away from work. If a man dissipates and abuses himself during his spare time, if he does not eat foods he should, and does not get the sleep he should, no effort to eliminate causes for fatigue within the shop can make up for the damage he does himself outside. Most excessive fatigue is undoubtedly due to the carelessness of men in their personal habits and in the extent to which they neglect their health. The most the foreman can hope to do in such cases is to exercise his best influence in an educational way with his men. He may even eliminate men from his force as bad accident risks if they are extreme in practices which lead to excessive fatigue. It is better foremanship to "sell" such men the wisdom of healthful habits. Then everybody profits.

It is perhaps safe to say that the majority of accidents result from the mental condition of the workman. The mental conditions which we refer to in our classification of accident causes are reflected in workers' carelessness, ignorance, recklessness, indifference, wilful disobedience and anxiety. The careless man is a dangerous man to have on a job. He is a menace not only to himself but also to his fellow workmen. The careless man does not take chances on purpose, but he simply goes ahead and does things without thinking. The indifferent man is very much like the careless man. Likewise, reckless men endanger themselves and their fellow workers. A reckless man can usually be held down by the foreman. It simply means that the foreman must know his men, when he has a reckless man in his department he must give him a good lecture every once in a while. Reckless men are usually hard, fast workers, who, with careful supervision, may be among the very best producers. There is no place in a plant for a man who wilfully disobeys orders. It is nothing short of criminal for a man to be disobedient with respect to regulations designed for his own safety and the safety of other men. Such a man is dangerous and does not deserve much consideration. A foreman should not keep such a man. Disobedience is one legitimate cause for discharge. Ignorance as a cause of accidents can usually be traced back to the foreman himself. The foreman is responsible for the ignorance of his men when they are not properly instructed by him. He is partially responsible for accidents resulting from the acts of men who lack ordinary common sense, for he should know the shortcomings of his men before giving them jobs. A man may be so "dumb" that he is unfit for work. If that is the case, the foreman should eliminate him at once.

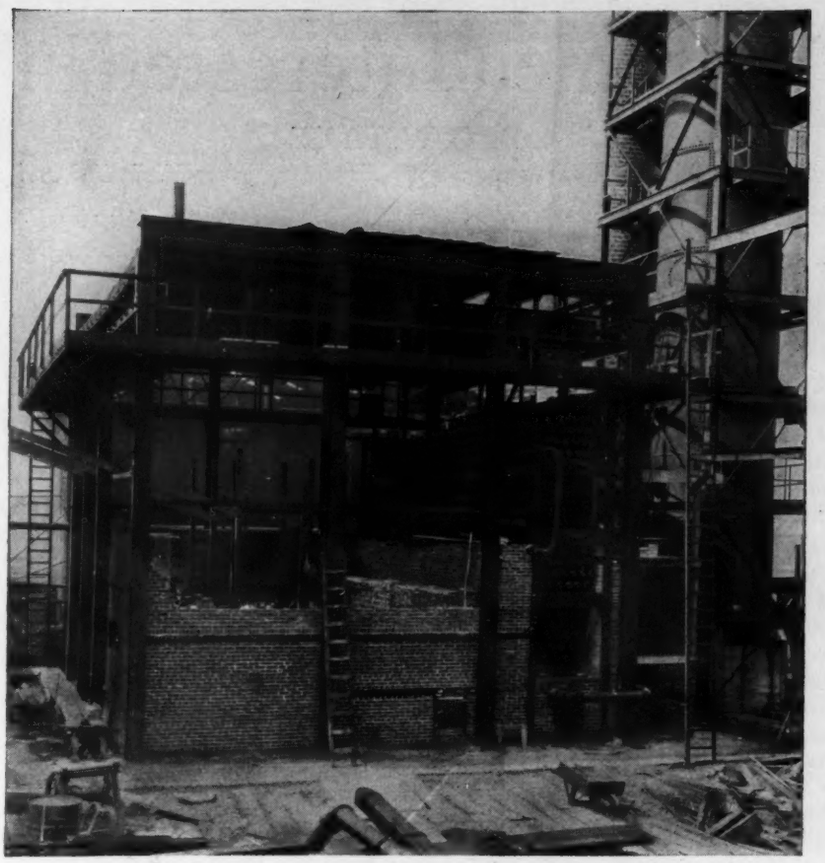
KEEP MEN SATISFIED

A foreman who does not get close enough to his men to let them know how they stand with him may be causing them a good deal of anxiety. The foreman who "bawls a man out" today for no good reason and treats him "decent" tomorrow keeps that man on the anxious seat, trying to figure out just how he stands with the boss. He wonders if the foreman is ever going to "come through" with the promised raise, worries about the steadiness of his job, the chances for promotion, the wages he is getting and any number of things may so occupy a man's mind that he does not think about safety. In this connection, the great value of contentment and good-will in the working force is evident. The man who is satisfied with his job, who feels that he is working for a good company, who has confidence in his foreman because he is a "square shooter," and who is working among contented, congenial, cooperative men, is certain to have a mind that is more free for application to his job than the mind of a man who is nursing a disgusted, discontented, suspicious attitude toward his job.

The foreman is not a doctor, but he is working day after day with his men, and is in a good position to observe the state of their health. There is nothing farfetched about the foreman's responsibility for the safeguarding of the health of his men. It is just as definitely one of his responsibilities as the lubrication of his machine equipment, the movement of material, or any of the other accepted functions of foremanship. Anything which contributes to the efficiency of his department in getting out his work may logically be regarded as a duty of the foreman. No one can deny that the prevention of sickness is a help in getting out the work. The foreman who believes in the idea of safe work, who impresses safety at all times upon his men and who constantly sets a good safety example for his men, is the most important single educationg influence that can be exerted among the workers.

The foreman should support every safety activity sponsored by the executives of the company. He should never lose sight of the fact that he is being paid to act as the company's representative and that it is his duty to carry out management's policies.

The time is passing when a foreman can forget the safety responsibilities of his job. The experience of companies who have made enviable safety records has demonstrated that the foreman is the company's best safety man. A plant cannot be made safe without the active cooperation of the foreman.



Foster Wheeler Distillation Units

The photograph shown was taken during the erection of a refinery unit consisting of a 14,000 barrel Foster Tubular Oil Still, a Foster Bubble Tower and the necessary Heat Exchangers, Pumps and other auxiliaries. The complete unit is being constructed on a single contract under which the overall results are guaranteed.

The heating surface of the Tube Still shown, consists of three distinct portions.

1. A roof surface composed of bare tubes covering the whole interior of the Still; this receives heat by radiation from the furnace.

2. A bank of horizontal oil heating tubes covered with cast iron extended heat absorbing surface and protected from the radiant heat of the furnace by means of an air cooled bridge wall. These tubes receive heat by convection from the furnace gases.

3. A steam superheater section consisting of four horizontal rows of superheater elements for superheating the steam used in fractionation. The superheater section is located about one-third of the way down in the convection bank, as shown in the illustration.

Perfection in control of fractionation exceeds that obtainable with any other system and provides independent variation of the products from each side stream without changing the conditions at other points in the tower.

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ECONOMIZERS EVAPORATORS
EXPANSION JOINTS FEED WATER HEATERS

Mention Where You Saw the Advertisement

Keep Workmen Interested in Safety

By C. W. PRICE

Director, Training Course for Safety Engineers, New York University.

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IN practically every company which has done successful work it has been found that the most successful method of maintaining interest on the part of workmen has been to give them some responsibility, some active part in helping to make their department safe. This has been accomplished by organizing what is known as workmen's safety committees. In a large plant a small committee should be appointed in each department. In a small company one safety commitee should be appointed for the entire plant.

The effectiveness of safety committee meetings depends largely on the foreman. The departmental committees should always be appointed by the foreman and should be carefully instructed by him. The members of the committee should be assured that the foreman appreciates the help which they will be able to give him in weeding out dangerous conditions and dangerous practices. The foreman should make it clear that he wishes the members of the committee to feel perfectly free to offer any suggestion which will help to make the department safe, and that the more suggestions they present the better he will like it. It is of the utmost importance in making the committee idea a success that the suggestions which are approved should be immediately carried out. Where the suggestions are not approved the foreman should take pains to explain to the workmen why they cannot be carried out. In this way he will retain their confidence.

It is customary in many plants to give the workmen opportunity—on company time—to make an inspection of the department and to submit to the foreman in writing a report of their findings.

A good practice is to appoint the members of the workmen's safety committee to serve three or six months. In organizing the first committee it is desirable to appoint one man for one month, one for two, and one for three. There will, then, always be two experienced men on the committee.

Twenty years' experience with workmen's committees demonstrates the following facts:

1. That 90 per cent. of the suggestions made by the safety committees are good and are accepted by the company.

2. When the members of the committee are appointed and begin to look for dangerous conditions and dangerous practices they learn for the first time, what it is difficult to convince them of by simply telling them that a large percentage of accidents cannot be prevented by the company but must be prevented by the men themselves.

3. When workmen have served on these committees they take a new interest in safety and begin to talk safety among their fellow workmen; this helps to build up a lasting enthusiasm

From the earliest efforts in accident prevention down to the present time the bulletin board has played an important part in helping to maintain interest in safety. In the average plant it has been customary to place a bulletin board at the entrance to the plant and another at the point where the men congregate at noon. The bulletin board should be well designed, should have a glass front, should be attractively painted, and equipped with a good light. The bulletin board should be made as attractive and interesting as a newspaper. This can be accomplished through the use of photographs, clippings from newspapers, official notices and plant news items, and an occasional or periodic message from the general manager or president.

In recent years a new use of the safety bulletin board has been developed. Simple boards are located throughout the plant to hold a series of large posters, each carrying the same message. These boards are so located that every man in the department, from the place where he is working, can see the poster and read the message. These posters are changed twice a month. The secret of making these posters effective is to have the messages done in such large type that they can easily be read from a distance of 50 feet, and especially is it important that the message shall have a certain clever turn, a certain punch, which will instantly catch the eye of the workman and grip his interest. The technique and the art of out-door advertising applies to the making of successful safety posters.

Here are a few sample slogans which have proved effective on such posters:

"Better be careful than crippled."

"One good leg is worth a whole woodpile of crutches."

"Ask the man in the hospital what he thinks of safety."

"His last words were 'safety is bunk.'"

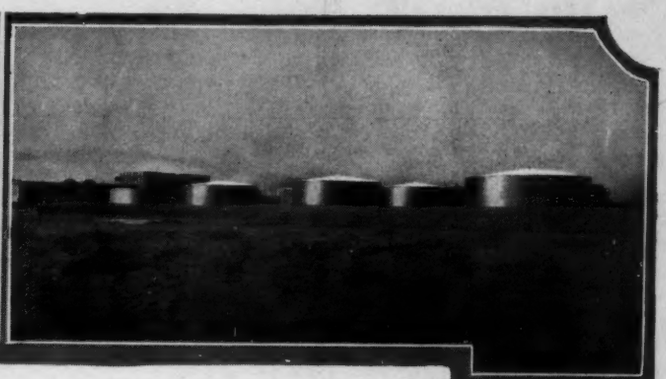
Plants having house organs or employes magazines can utilize these also to maintain interest in a safety campaign with a column, a page, or several pages devoted to safety. Such a department should publish messages from an officer of the company, statistical records of the departments and of the plant as a whole, and the minutes of workmen's safety committee meetings. The publishing of meritorious suggestions with the names of the men making them, encourages others to make suggestions.

The cost of maintaining effective bulletin boards is small, and a little well-directed effort will go a long way toward keeping up the interest aroused among workmen at the beginning of a campaign. Many companies have spurts of safety activity which result in better records, but interest is allowed to die out, and conditions become as they were before. The bulletin board can help prevent this by supplementing the work of foremen, workmen's committee, and the safety engineer.

The safety poster should appeal to the emotions rather than to reason. Herbert Spencer said that nine-tenths of our lives are controlled by emotions and one-tenth by reason. This principle should be followed in a safety poster campaign.

The day of the poster dealing with specific hazards is probably past. A poster showing a man using a saw without a guard is of little value, because it does not move the workmen to do anything.

To have continued good results from them, posters should be changed frequently. They may be made by some person in the plant able to do art work, or they may be purchased at a low price from one of the several poster services.



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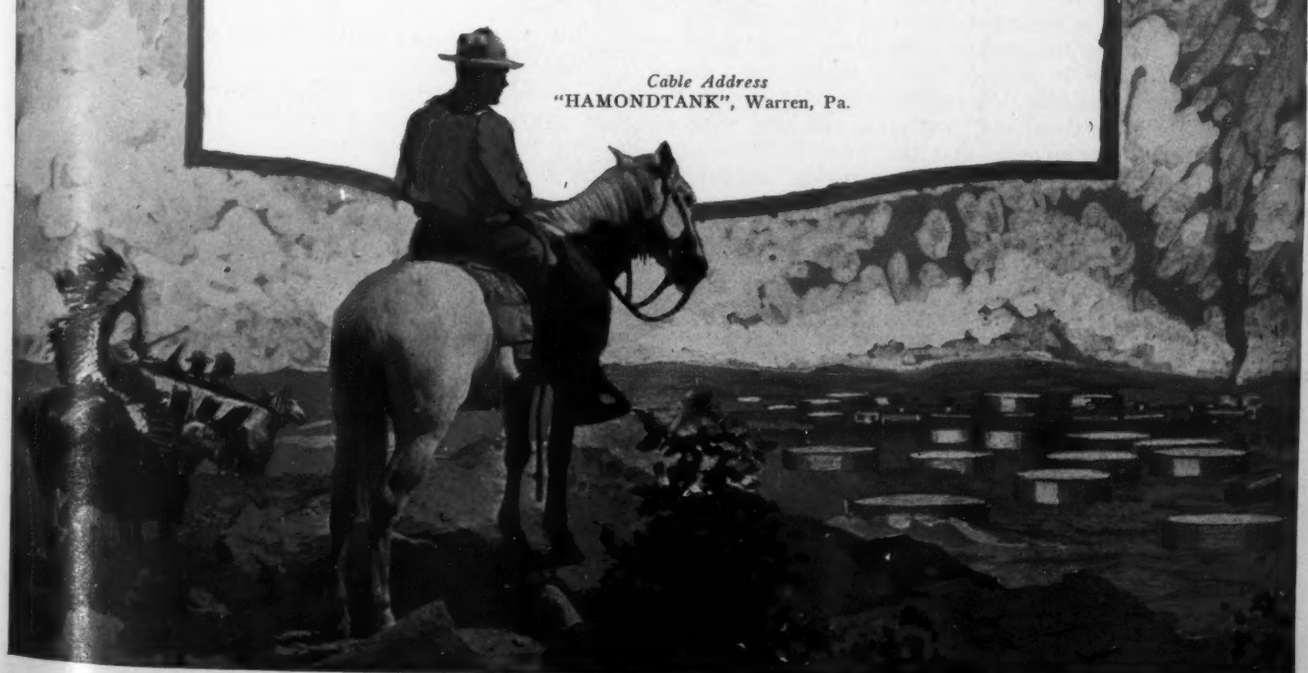

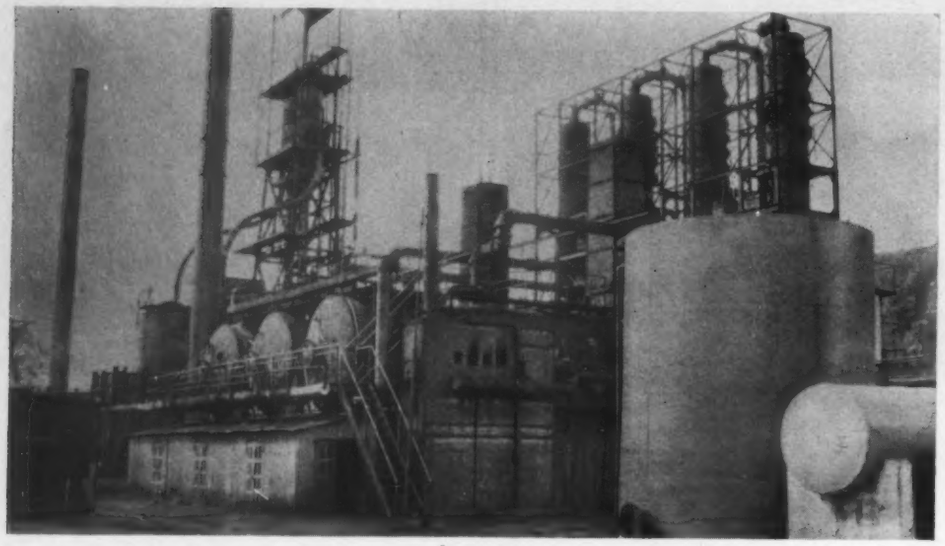

Kendall Refining Company's battery of stills employed in redistillation of straight run re-run stock blended with pressure distillate from the Dubbs cracking units.

Redistillation Fitted to Cracking Units in Kendall Plant

THE Kendall Refining Company, operating its complete refinery at Bradford, Pennsylvania, has equipment for skimming, cracking, and redistillation, in addition to the usual departments conjunctive to the manufacture of lubricating oils and waxes. Modern equipment is employed in the processing of its oils in such departments as distillation, chilling, dewaxing, filtering and revivification of fullers earth through the use of Nicholls-Herreschoff furnaces. The plant operates on crude from the Bradford field.

With the installation of its two Dubbs cracking units some years ago, came the need for adequate redistilling equipment to handle the pressure distillate from these units. Following the dictates of best economy, the company designed its redistillation equipment to incorporate the utilization of its three old Snodgrass cracking stills. It is interesting here to note that the Kendall Refining Company was experimenting with cracking as long ago as 1913. The Snodgrass equipment became obsolete, and the heavy 5/8-inch shell stills were converted into a re-running battery operating continuously. Fractionating, condensing and cooling equipment, as well as automatic temperature control devices were installed of the latest modern type. H. S. Bell, refining engineer, was called in as consultant, and the bubble towers installed are of his design.

Formerly the battery was charged with pressure distillate but later additional charging stock was taken from the skimming plant which increased the through-put of the battery, and necessitated the installation of a reboiler section, to secure better stripping. This will be discussed later. The rerun stock from the skimming plant yields naphtha and kerosene when distilled, and the distillation procedure is carried out by blending the straight-run-rerun-stock with the pressure distillate from the Dubbs units in such proportions as may be necessary according to stocks on hand.

Four fractionating columns are employed with the three stills, and four Leach vapor heat exchangers. Stock charged to the unit passes from the Worthington duplex pump, size 9 x 5 by 10, of which there are two, one being reserve equipment, directly into the first Leach vapor heat exchanger installed on the vapor line leading from the bubble tower to the Sterling condenser sections. From this exchanger it flows progressively through the remaining three exchangers installed on vapor lines leading from the remaining three columns. This exchange gives a preheat of 325 degrees.

FLASH TOWER

From the exchangers the oil passes into the first bubble tower, which is termed a flash tower. The top of this flash tower is under automatic temperature control, holding the temperature at the tower top at 250 degrees. All of the towers are controlled by Tagliabue automatic temperature controllers. Temperature charts are recorded by Leeds-Northrup recording instruments. The stream of light gasoline taken from the flash tower is taken through condenser and to the receiving house, passing through a Southwestern after-cooler, upon leaving the condensing sections. This type of after-cooler is installed on each of the four streams.

The flash tower drains or refluxes into No. 1 still and flows progressively by gravity through the remaining two 10 by 30 shell stills. A second stream of gasoline is removed from the first still, the vapors passing through No. 2 bubble tower. This tower is equipped with but five bubble trays, whereas No. 1 flash tower has eight. The still is heated to 390 degrees and the tower-top control holds a constant temperature there of 290 degrees. In each case the recycle stock employed as control media is the finished product off of the tower being cooled.

Leaving No. 1 still, the residual oil passes into No. 2

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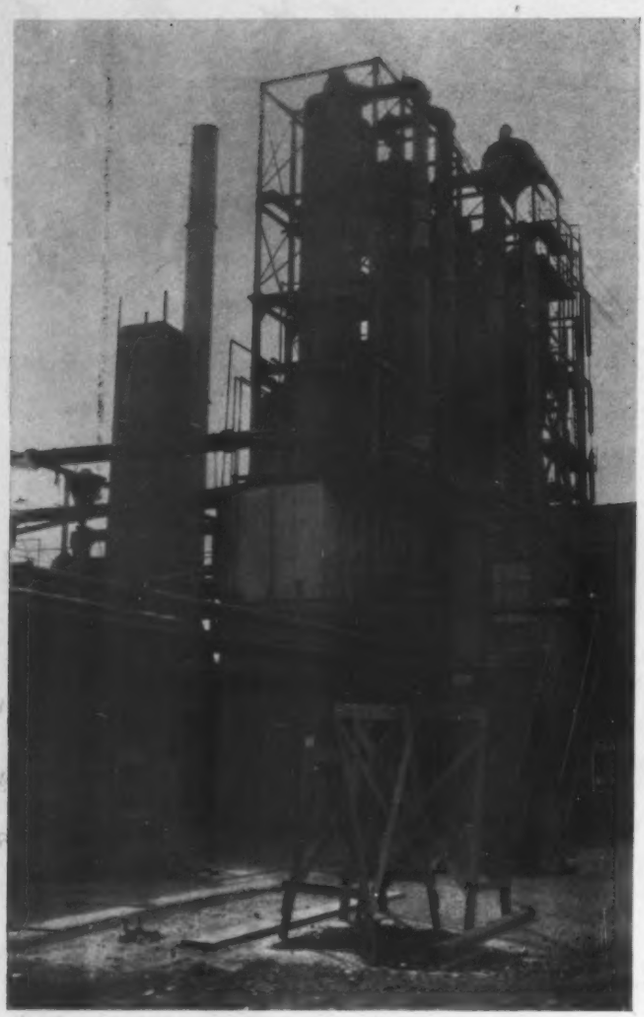
PULMOSAN SAFETY EQUIPMENT



Fractionating equipment equipped with vapor heat exchangers. Bubble type columns. Note all structural steel support work insulated with brick.

of the series where it is heated to 450 degrees. The vapors passing off of this still are conducted to the third tower, which is a complete bubble tower having 11 bubble trays. It was at this point that changes were necessary when the different charging stock was blended and run through the battery in greater quantity. In order to secure better stripping and a closer fractionated naphtha overhead from this tower it was necessary to install a reboiler by means of which the reflux leaving the bottom of the tower could be reheated and stripped of any light materials which had condensed in the tower as reflux.

A Ross exchanger type reboiler was installed at the base of the tower, through which the reflux must pass to be heated to higher temperature by the residuum from the final still in the series. A Worthington pump, size 9 x 5 x 10 takes suction on the last still and discharges the residual oil at about 500 degrees into the Leach reboiler. At this temperature any light ends left in the reflux from the tower are removed and returned to the bubble tower through a small vapor line entering the tower at about one-third of its height. A stand-by pump of the same size is installed in the pump house as a pump-out instrument if ever needed.

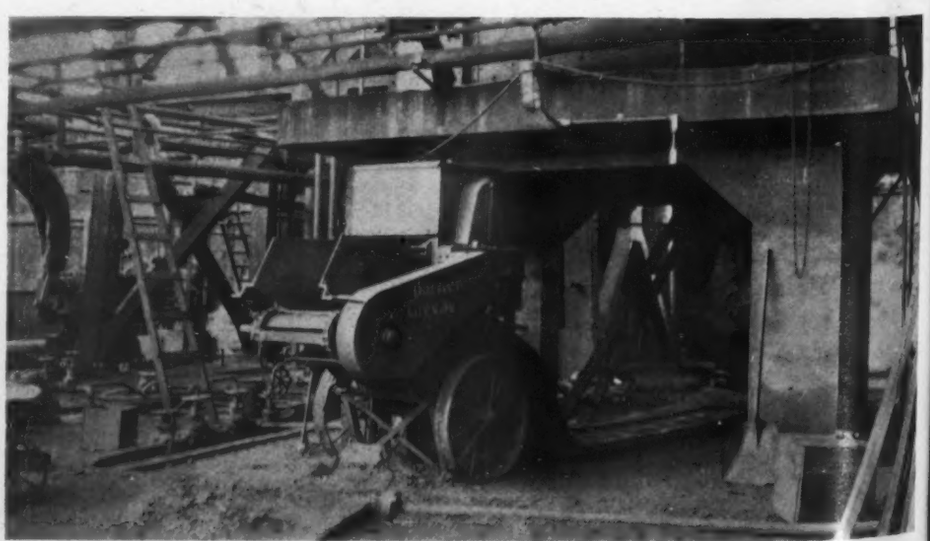
Naphtha vapors taken over head from the third tower are held at 350 degrees by automatic control. This product is employed in absorption plant work at the company's gasoline recovery plant, which removes the gasoline from gas from Dubbs units, before this gas is consumed as fuel under the stills.

HEAT EXCHANGE

The third still in the series is heated to 500 degrees and the vapors fractionated in the fourth bubble tower are kerosene. Tower control gives a constant temperature at the top of the fourth bubble tower of 420 degrees. This tower is also equipped with but five bubble trays. All of the reflux pumps, of which there are five, one being stand-by equipment and so manifolded that it can work on any tower, are Worthington 5¼ x 3½ by 5 size. Charging stock is metered to the rerun units through a National meter.

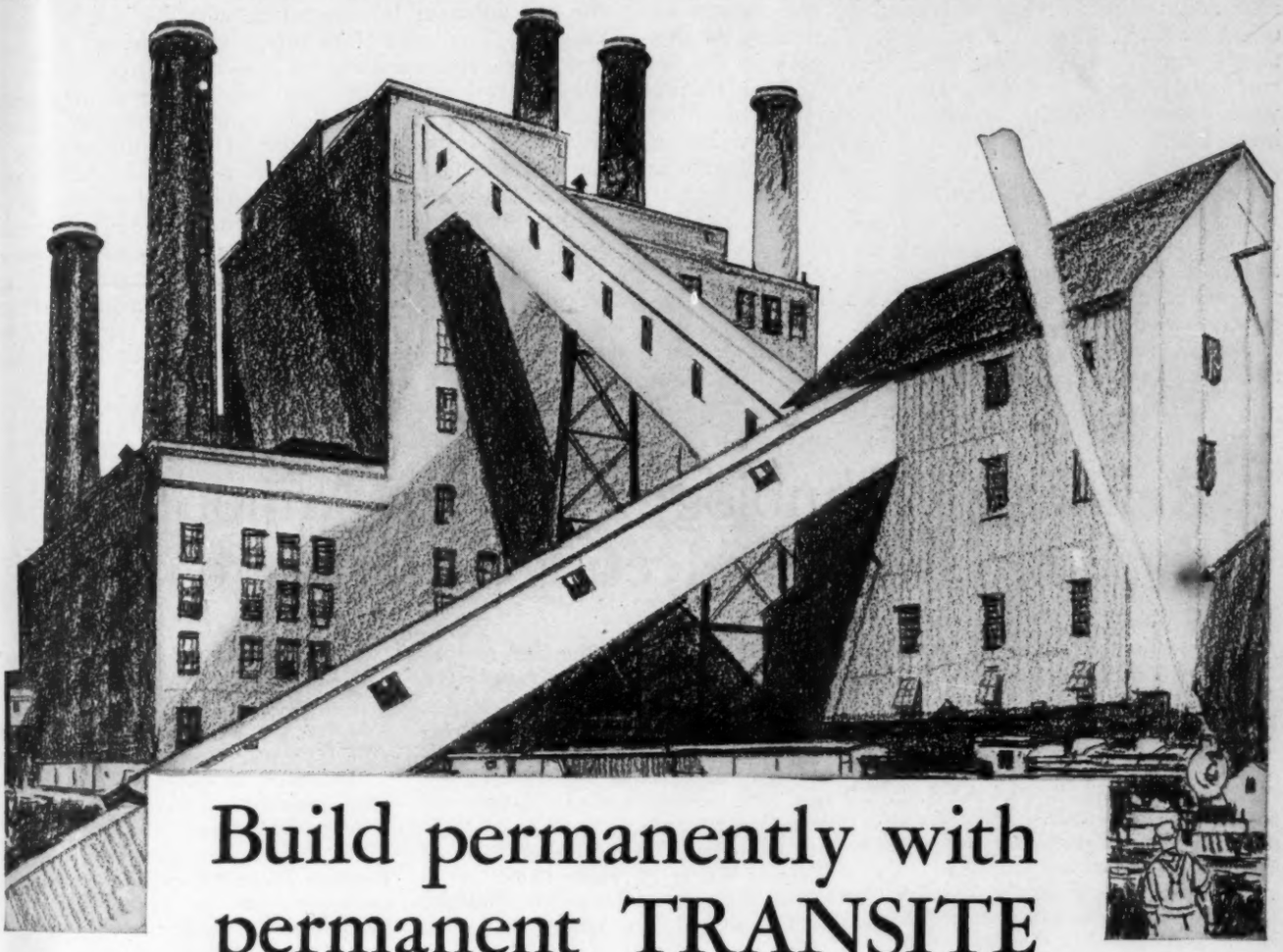
Each of the Leach vapor heat exchangers is so installed and manifolded that any one of them may be cut out of the system at any time without greatly impairing the efficiency of the exchanger process. The by-pass equipment is not expensive to install and certainly saves its cost many times in the elimination of shut downs for repairs or cleaning of a single heat exchanger. When pressure distillate is redistilled there is usually periodical trouble arising in the matter of dirty exchanger equipment. With the proper by-passes, the battery may be kept in constant operation. Pressure distillate must be acid treated prior to redistillation, and common practice in the treating department does not render it non-corrosive. At this plant the pressure distillate and acid mixture is circulated through the batch agitators by means of electrically driven Duriron pumps —and subsequently neutralized with caustic. It is then ready for redistillation—being blended with the straight run re-run stock.

Exhaust steam from the several duplex steam pumps employed in the operation of this rerun battery, is taken from the pumps and passed through a small Foster steam superheater. This heater is gas fired, and the gas is derived from the absorption plant, and



Car unloader used at Kendall's plant for moving coke from under the reaction chamber to the nearby coke loading rack. Part of the conveying belt is not shown here.

THE TALL TOWERS OF INDUSTRY WILL STAND FOR CENTURIES IF THEY ARE WALLED AND ROOFED WITH TRANSITE



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primarily from the Dubbs units. In the superheater the temperature of the steam is raised to 350 degrees. It is held constant at 15 pounds pressure by Tagliabue controllers which hold it at this working pressure and also admit any live steam needed by the system to effect maintenance of the pressure. The steam at this temperature is employed in distillation work in the rerun battery just described, and makes for operation with lowered firing. The rerun battery is oil fired instead of being coal fired, as is usual Pennsylvania practice. When both Dubbs units are in operation, sufficient gases are run through the absorption plant to permit firing of some of the stills with gas. The exhaust steam from the operating pumps is more than ample for the operation of the three stills in the rerun battery, and the remaining steam is used for distillation work in another still battery.

At the cracking plant the company has an intersting and handy feature in service in the matter of handling coke from the reaction chambers. In one of the accompanying photographs there is shown a Barber-Greene car unloader in position at the side of the Dubbs chamber. When the cable is pulled and the coke dumped the car unloader is in position with its belt conveyor moving. The coke falls upon the moving conveyor and is transported away to a second conveyor belt, to finally be dumped into the coke pile not many feet away from the unit. This conveyor or unloader is motor driven. It is but a matter of a few minutes labor to move the conveyor belt, machine and all from one chamber to another, and the familiar wheel barrow is completely removed from the picture. The Kendall company finds a ready market for its coke and can therefore afford to convey the production of coke but a few steps away from its source at the cracking unit. There is no coke pile at the Kendall plant, for car load shipments tend to keep this familiar sight at least below the level of the fence surrounding it.

Refinery Technology Program Announced for A. P. I. Meeting at Chicago

THE tentative program for the meeting of the American Petroleum Institute in Chicago December 3, 4, 5 and 6, provides for five meetings of the Division of Refinery Technology. The meeting will be held this year in the Stevens Hotel, which housed the A. P. I. annual session in 1927. While the program issued is tentative, very few changes are likely to be made.

The first meeting of the Division of Refinery Technology will come the morning of December 5 at 10 o'clock with the following program:

Chairman: P. M. Miskell, Empire Refineries, Inc.

"Utilization of Heavy Oil Acid Sludge," H. G. Osborn and L. L. Davis, Marland Refining Company.

"Process Conversion of Cylinder Stock Sludge to Plant Fuel Oils," L. W. Barbour, Pierce Petroleum Corporation.

"Control of Refinery Odors," David E. Day, Richfield Oil Company.

"Refinery Evaporation Conservation," E. C. Herthel and William Mendius, Sinclair Refining Company.

"Burning of Clay in Multiple Hearth Furnace," MacLean Houston, United Refining Company.

"Use of Some Catalytic Agents in Revivifying Used Filter Clay," F. R. Lang, Roxana Petroleum Corporation.

The afternoon of December 5 the session will have the following program:

Chairman: John L. Gray, Shaffer Oil & Refining Company.

A discussion of the relative advantages of vacuum as compared with the use of steam at atmospheric pressure.

"Reducing 2500 Barrels of Pennsylvanian Crude Per Day to Cylinder Stock Bottoms on Single Pass Pipe Still," A. C. Vobach, Sinclair Refining Company.

"Applications of the Pipe Still to Vacuum Distillation," A. E. Harnsberger, Pure Oil Company.

"A Summary of the Relative Advantages of Pipe Still Distillation under Vacuum and with Steam at Atmospheric Pressure," W. A. Peters, E. B. Badger and Sons Company.

"Equilibrium Vaporization of Oils and Carrying Effect of Light Ends," R. F. Piroomov and G. A. Beiswenger, Standard Oil Company of New Jersey.

The third meeting of the Division of Refinery Technology will be held the evening of December 5 at 8 o'clock with the following program:

Chairman: (To be announced.)

"Developments in Refinery Technology," E. W. Isom, Chairman, General Committee on Refinery Technology.

Paper (subject to be announced), A. E. Dunstan, Anglo-Persian Oil Company.

"Topping and Cracking of West Texas Crudes and Treatment of Distillates from these Crudes," H. H. Hewetson, Beacon Oil Company.

"The Refining of Pecos Crude," Sydney Born, Transcontinental Oil Company.

"The Relation of Liquefied Petroleum Gas Industry to the Oil Industry," R. C. Alden, Phillips Petroleum Company.

Thursday, December 6, the morning meeting of the Refinery Division will be at 10 o'clock with the following program:

Chairman: (To be announced.)

"Testing and Maintenance of Fire Foam Solutions," J. B. Rather and D. P. Weld, Standard Oil Company of New York.

"Automatic Viscosimeters," Clifford M. Larson, Sinclair Refining Company.

"Development of the Logarithmic Viscosity Temperature Chart," Neil MacCoull, The Texas Company.

"Methods of Testing Gear Lubricants," C. L. Knopf, Sinclair Refining Company.

"Formation of Acetic Acid in Heat and Pressure Cracking," F. W. Hall and R. deM. Taveau, The Texas Company.

"Treatment of Naphthene Base Petroleum Distillates," G. F. Olsen, General Petroleum Corporation.

The final meeting of the Division of Refinery Technology will be held the afternoon of December 6, at 2 o'clock, with the following program:

Chairman: (To be announced.)

Two papers covering the results of the Co-operative Motor Fuel Research at the Bureau of Standards (subjects and speakers to be announced.)

"The Accuracy of Various Methods of Determining Detonation," Neil MacCoull, The Texas Company.

"Service Testing Methods for Petroleum Products," Alois Kresner, Standard Oil Company of California.

"Significance of Gum in Gasoline," R. E. Wilson, Standard Oil Company of Indiana.

O. W. Crick, former district sales manager of the Phillips Petroleum Company at Amarillo, has assumed charge of the credit department of the Independent Oil & Gas Company at Tulsa. Before going to Texas with the Phillips Company he was with the Highway Oil Refining Company in Tulsa.

The Woodley Petroleum Company, City National Bank building, Shreveport, Louisiana, is reported to be planning the erection of a three to four million cubic foot daily capacity absorption gasoline plant on its producing leases in the Cotton Valley field.

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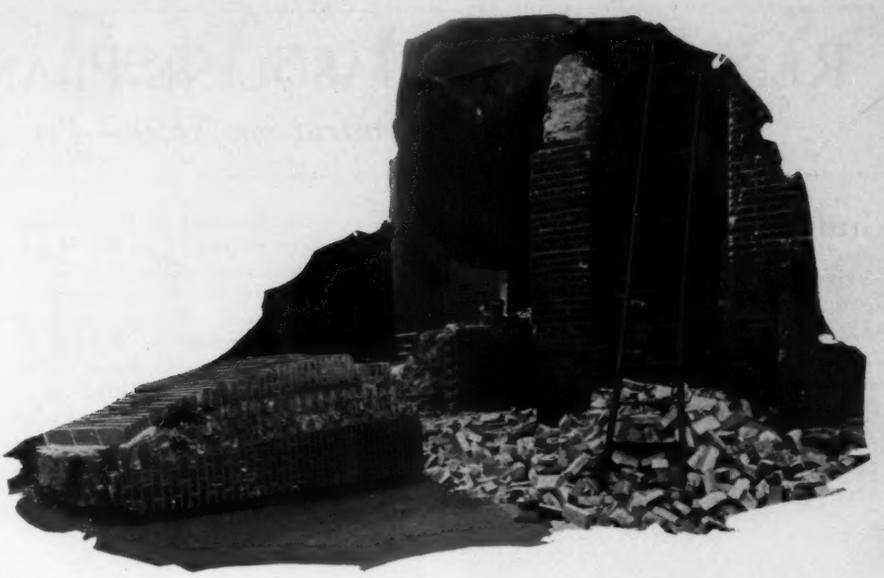

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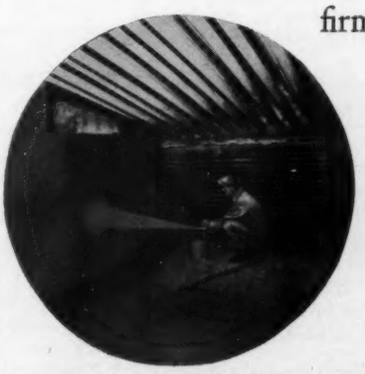

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REFINERY AND GASOLINE PLANT ACTIVITIES

New Plants – Construction Notes – Personnel Changes

Graf Zeppelin Fueled With Ethane

When the Graf Zeppelin, monster German dirigible, recently visiting the United States, was made ready for its return flight across the Atlantic Ocean it was fueled with American ethane gas especially prepared for the flight at a Kentucky natural gasoline plant.

The fuel was prepared at the natural gasoline plant of the Louisville Gas & Electric Company at Winchester, Kentucky. When the giant Zeppelin left Germany on its maiden voyage to the United States there was some conjecture as to how and where its owners would procure an adequate supply of gaseous fuel of the type required sufficient to operate its large motors on the return trip. The question was solved some weeks ago when the natural gasoline branch of the petroleum industry was called upon to offer suggestions.

The Louisville Gas & Electric Company, which is a subsidiary of the Standard Gas & Electric Company, conducted the research and experiments necessary to the isolation of practically pure ethane gas and delivered the required amount, 1,000,000 cubic feet, at Lakehurst, New Jersey, October 1.

How the manufacture of this gaseous fuel was prompted by the visit of the Graf Zeppelin to the United States has been described by Herman Heck, chemical engineer for the Louisville Gas & Electric Company, who says in part, that the new fuel is ethane gas made by a fractionating process from natural gas, for use in the motors of the huge dirigible, stating further that ethane gas has a specific gravity of 1.04, approximately the same as air, and when carried in balloon nets it does not increase the Zeppelin's load, and when it is burned in the motors, does not decrease the load as gasoline or any other liquid fuel would do.

The required 1,000,000 cubic feet of the new fuel was manufactured at the plant of a subsidiary company, the Kentucky-Oxygen-Hydrogen Company, which was in some measure redesigned especially for the purpose. This work was done under the supervision of R. W. Bottoms, who is an authority on helium gas and fractionating processes, and who is now director of research for the Kentucky Oxygen-Hydrogen Company. Mr. Bottoms was formerly a lieutenant in the United States navy and was connected with the navy's helium gas experiments and researches.

The navy department of the United States has been requested by Dr. Hugo Eckener, commander of the Graf Zeppelin, to ascertain if a gaseous fuel could be prepared in this country which could be successfully utilized by the Zeppelin on its return flight. The navy department communicated with Mr. Bottoms and his company, and they in turn, agreed to make the necessary experiments in fractionation to the end that practically pure ethane would be delivered at Lakehurst for the refueling of the giant dirigible.

At the natural gasoline plant at Winchester, Kentucky, it was found that the by-product gases from the operation of the plant contained 40 to 50 per cent of ethane. All of the natural gasoline is first removed by the usual gasoline plant processing methods, leaving a by-product gas rich in ethane. Mr. Bottoms developed the fractionating processes, and with the assistance of Mr. Heck manufactured the 1,000,000 cubic feet of ethane gas from approximately 3,000,000 feet of the by-product gases. It is reported that the methods used consisted of recompression of the by-product gases to a pressure of 250 pounds per square inch, and the fractionation by expansion methods at a temperature around minus 50 degrees Fahrenheit.

The experimenters responsible for the refueling of the Graf Zeppelin state that ethane gas very nearly approximates the German Blau gas, a by-product of manufactured gas which was employed as fuel by the Zeppelin on its flight to this country. Hydrogen gas is used in the dirigible bag to sustain it in the air, and the blau, or the ethane gas, is carried in small balloon nets beneath the large bag.

Commenting on the efficiency of the ethane gas, Lieutenant Commander Z. W. Wicks, in charge of the fuel arrangements for the airship, stated that the fuel gas, ethane, after tests in the German engines, was completely satisfactory and that the Germans stated it to be superior to and having a higher calorific value than their Blau gas.

G. L. Rowsey, who was for several years superintendent of the refinery of the Amarillo Refining Company at Amarillo, is now in charge of construction for the Great West Refining Company, which is building a 5000-barrel refinery at Big Spring, Howard County, Texas. Reese S. Allen, former owner of the Amarillo refinery, is president of the Great West Refining Company. Mr. Rowsey will continue in charge of operations after the Big Spring refinery is completed.

Four Plants Being Built at Big Spring

Big Spring, Texas.—Operation of the first of a quartet of refineries being erected near Big Spring to operate on crude produced in the Chalk-Roberts field was started early in October, and the remaining three plants are scheduled to be completed before the end of the year. These plants will make Big Spring a prominent refining center in the West Texas district, with a slight freight advantage over other refining centers in the district, but with similar crude costs on an average.

The Big Spring Refining Company, which dismantled a small skimming plant at Greenville, Texas, and after moving it to a site west of Big Spring made considerable changes and enlargements, began operating early in October. This plant is rated good for 2500 barrels daily, and receives its crude through the Big Spring Pipe Line Company's 15-mile four-inch line, paying a tariff of 12½ cents per barrel. Charles R. Groff is president of the Big Spring Refining Company, and R. S. Peterson is vice-president in charge of the plant operations. Altitude Petroleum Company, Tulsa, has contracted to market the output of the plant.

J. S. Cosden, veteran refiner in the Mid-Continent district, will be back in the refining business on a large scale towards the end of the present year through his control of three separate plants on adjoining sites, located on the Texas & Pacific Railroad and west of Big Spring. Cosden & Company, which is headed by Mr. Cosden, is having a skimming and cracking plant erected on contract by The Graver Corporation that will be equipped with two type "5-A" Jenkins cracking units of 1000 barrels capacity each and a 5000 barrel capacity pipe still, which is being furnished and installed by the Foster-Wheeler Corporation. Cosden & Company, has sold 1,000,000 barrels of fuel oil at a reported price of 80 cents per barrel to be manufactured by this plant. Wayne P. Rice, formerly general plant superintendent for Marland Refining Company's Ponca City plant, has been made manager of refineries for Cosden & Company.

Richardson Refining Company, which was organized in August with W. D. Richardson of Tulsa, president, is erecting a plant similar to that being built by Cosden & Company, on the same site, but north of the railroad. J. S. Cosden controls 51 per cent of the stock of the Richardson Refin-

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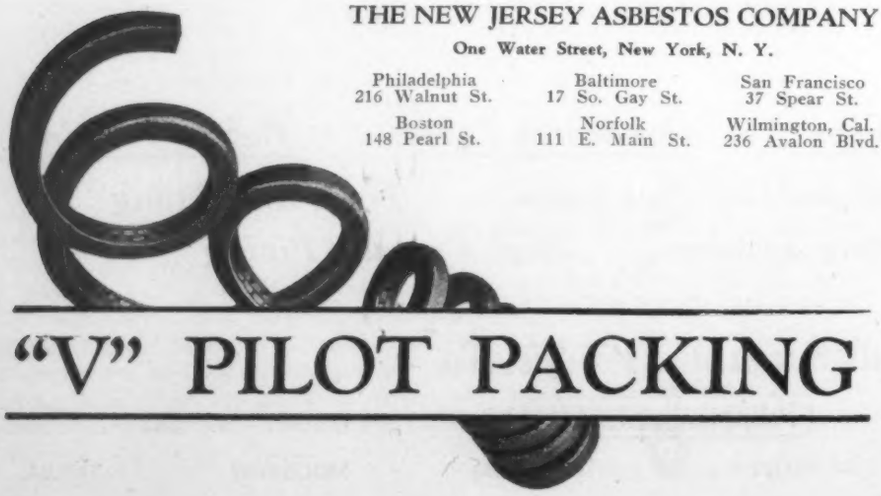


"V" PILOT PACKING

ing Company. This plant will be completed late this year also, and will obtain its crude supply from Cosden & Company's producing properties in the Chalk-Roberts field, deliveries being made by the Cosden Pipe Line Company's eight-inch line, which has been completed.

Cosden became affiliated with the Great West Refining Company, which is erecting a 3000 barrel skimming unit on the east side of Cosden & Company's plant, through purchase of one-quarter of the stock. F-H-E Oil Company and the Laurel Oil & Gas Company, leading independent producers in the Chalk-Roberts field, also subscribed to the stock, thus assuring a crude supply through these stockholders. The Great West Refining Company was organized by Reese S. Allen, Wichita Falls refiner, with a capital stock of $200,000. G. L. Rowsey, who is general superintendent for Mr. Allen's plant at Pampa, Texas, is supervising construction work on the Big Spring plant. The Great West Pipe Line Company was organized by Mr. Allen to build a line from the plant to the field for the crude supply.

Phillips Building More Plants in Panhandle

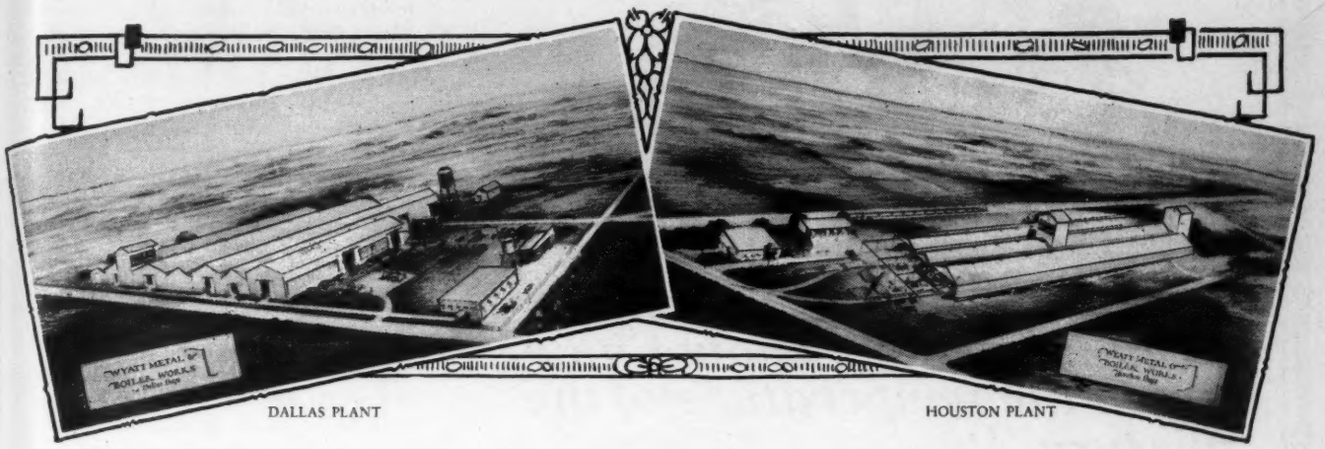
Amarillo, Texas. — Phillips Petroleum Company is expanding its natural gasoline manufacturing facilities in the Panhandle area of Texas through the addition of three new plants all of which are to operate on well-pressure.

The first of Phillips Petroleum Company's well-pressure plant was erected early this year in Section 22, Block Y, Hutchinson County, to utilize lean gas then going to waste in the main part of the Borger field. Following the successful operation of this large plant the company authorized the construction of three additional units.

One of the three new plants will be installed at the Pampa plant, located in Section 88, Block B2, Gray County, where the original plant is producing about 35,000 gallons of gasoline daily. The new or well-pressure unit will have a rated capacity of 20 million cubic feet of "lean" gas and produce 8000 to 10,000 gallons of gasoline per day.

The other two units are being installed at the Johnson plant in Section 69, Block 46, H. & T. C. Survey, Hutchinson County, and at the Texroy plant in Section 3, Block B-3, Hutchinson County. Both of these original units have a capacity of 40 million cubic feet of gas daily. There is, however, much lean gas now going to waste near them and the new plants going in are designed to strip this lean gas. The well-pressure plants operate without compressors and are for this reason somewhat less expensive to install and operate.

The General Petroleum Corporation,



DALLAS PLANT HOUSTON PLANT

Wyatt Announces Houston Plant

Expansion Program Gives Southwestern Company Equal Facilities With Northern and Eastern Plants

IN keeping with the growing importance of the Southwest as an industrial center and as an industrial market the Wyatt Metal & Boiler Works has started construction of a Houston plant. This plant, with an initial floor space of 75,000 square feet, will be located on the M., K. & T. and Southern Pacific tracks at Washington Avenue.

Wyatt's builds tanks of every character from steel plate, including pressure and storage tanks; refinery equipment; smoke stacks; breechings; air ducts; natural gasoline plants; bulk storage tanks. In addition, the company builds road culverts, road strips and all kinds of galvanized, plain and corrugated metal work.

The Houston plant will be specially equipped with machinery for building the heavy plate work in both riveted and welded construction now required in modern refining practice. Gulf Coast refining interests who have depended upon Chicago, Pittsburgh and Birmingham districts can now be served in the Houston territory.

Additional special equipment will include 36-foot bending rolls, plate planer and G. E. automatic arc welding machines. These machines will build welded steel pipe, cylinders and tanks in 36-foot lengths from a single plate and having a joint of 100% efficiency or equal strength to the solid plates.

Already one of the largest builders of underground storage tanks for filling stations, Wyatt's is installing automatic electric welding equipment to manufacture these tanks entirely by the automatic process.

With its Dallas shops containing 100,000 square feet of floor space, or a total of 175,000 square feet in the two shops, Wyatt's will have capacity for fabricating 25,000 tons of plates and sheets. The two shops will have more than 400 employees and an annual pay roll of $700,000.

WYATT METAL & BOILER WORKS
Capital $1,000,000
DALLAS, TEXAS

Wyatt's

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"What'll I do? Otto is home sick and no one knows how to tell the temperature of the mixture."

That's the predicament you may be in some day if you rely on men to do the work of temperature regulators. More goods are ruined, more shipments delayed and more customers lost than you probably realize by trying to save a few dollars initial investment in temperature regulators and making men "guess" at temperatures.

Once set for a given temperature, Sarco Regulators maintain exactly that temperature without attention, and any man can then tell the temperature.

The Sarco costs but little to buy and requires no expensive pipe lines to install, as it is entirely self-contained and needs no compressed air, water pressure or electricity to operate.

Let us send you a Sarco entirely at our risk. Try it for 30 days and then send it back if you are willing to part with it.

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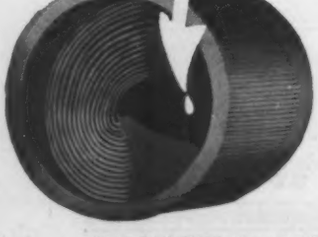
SARCO TEMPERATURE REGULATOR

The Spiral Motion Is the Trick



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Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request

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a subsidiary of the Standard Oil Company of New York, will immediately start construction on a 30,000-barrel refinery near Torrance, California, where it owns a large site purchased two years ago. Two units will be built at once, including complete distillation equipment, run-down tanks, boilers and gasoline treating apparatus. A total of nine, 134,000-barrel tanks and four 80,000 barrel tanks will be erected. The new plant will cost about $3,000,000.

Improve Plant

The Roxana Petroleum Corporation's refinery at Arkansas City, Kansas, has plans for enlargement and improvement. About $500,000 will be spent on the work, and the output of the plant will be greatly increased. The new work will include the addition of two units, and the installation of new equipment in the present buildings.

Seneca Plant Sold

The Swan-Finch Refining Corporation has concluded negotiations for the purchase of the plant of the Seneca Oil Works, Inc., Franklin, Pennsylvania, which will be developed as its main refining works. An expansion program which will involve the expenditure of about $300,000, will include the installation of considerable additional machinery. A portion of the plant will be given over to gasoline refining.

Consolidation

Headquarters of the newly organized MacMillan Petroleum Corporation, capitalized at $3,000,000, will be in Los Angeles.

The Corporation was formed through a merger of the MacMillan Petroleum Company and MacMillan Refining Company of Amarillo and Borger, Texas, with the Independent Oil Company of California and the Boner-Sheldon Company, the latter of which owns certain refining patents and processes. The M. & M. Oil Company and the Coast States Oil Company will be affiliated with the new corporation.

The MacMillan Petroleum Corporation will operate three refineries, located at Long Beach, Borger, Texas, and El Dorado, Arkansas; and other assets include considerable acreage and fairly large production of Crude oil.

The Hagaman Refining Corporation, which has been operating a skimming plant near Ranger, Texas, at part capacity almost continuously since its completion in 1919, has been re-organized following the retirement of M. H. Hagaman, Ranger, president and general manager, and the name changed to Superior Refining Company. G. A. "Jack" Clements and R. D. Gholson, both of Ranger, acquired Hagaman's stock in the plant, and have started work on re-conditioning it. Crude supply is obtained from Ranger district fields through The Texas Pipe Line Company. The plant is rated good for 1800 barrels daily.

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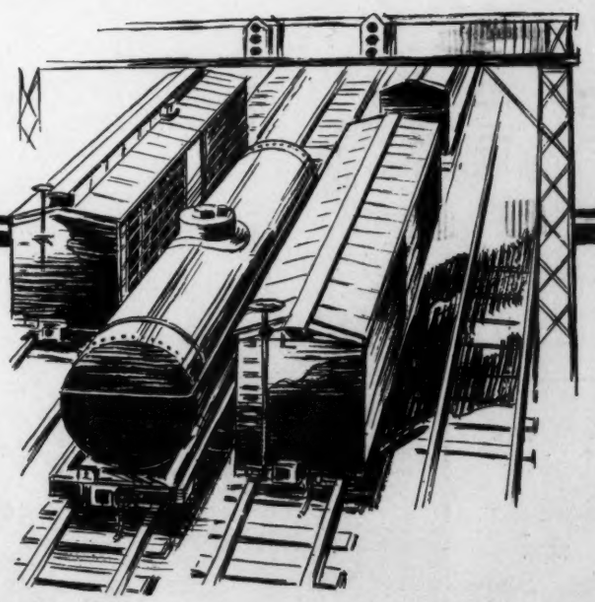

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REFINERY RESUMES

Tulsa — Handling about 1000 barrels daily, the Walters Refining Corporation is now operating the Walters, Oklahoma, refinery, which was built in 1920 by the Southern Oil Corporation and which has been shut down for the past several years. Crude supply for the plant is from Winkler, County, Texas, and Duncan, Oklahoma.

Officers of the Walters Refining Corporation include Charles R. Virtue, of Yale, Oklahoma, president; Herman Sinken, vice president; B. E. Moses, secretary, and C. J. Doney, treasurer; the three latter all being of Kansas City. The Petroleum Oil Corporation of Kansas City and Tulsa will take care of the sale of the products of the new refinery.

REHABILITATE REFINING

Fort Worth, Texas—The Star Refining & Producing Company has started work on making a number of improvements to its skimming and cracking plant located at Fort Worth, after sustaining considerable damage early in September by a fire and explosion. A number of small tanks are being erected to replace those lost in the fire, as well as new oil lines leading from the stills. An underground drainage system is included in the list of improvements to be made, while vapor proof roofs are being placed on all old tanks also.

TEXAS BUYS REFINERY

Amarillo, Texas—The Texas Company has purchased the Amarillo Refining Company's 4000-barrel daily capacity skimming plant, located near Amarillo, from Reese S. Allen, Wichita Falls, and associates, and will increase the capacity of the plant. This plant was built several years prior to the establishment of commercial crude production in the Texas Panhandle district, and when a major producing area was uncovered in Hutchinson and Carson Counties, the Pantex Pipe Line Company built a line, consisting of 43 miles of six-inch pipe, from the above two counties to the plant, making first deliveries in October, 1924.

In connection with the refinery purchase, The Texas Company has arranged to run through a large portion of its high gravity crude now being produced in Gray County section of the Panhandle, and The Texas Pipe Line Company is building a 25-mile six-inch line from the town of Panhandle to Amarillo.

Judge C. D. Chamberlin, advisory counsel of the National Petroleum Association, died October 24. Judge Chamberlin had been connected with the association, since his appointment as secretary in 1906. He became general counsel in 1917 and advisory counsel in 1926. His funeral was held at Clinton, Michigan, October 26, and burial was at Bedford, Ohio.

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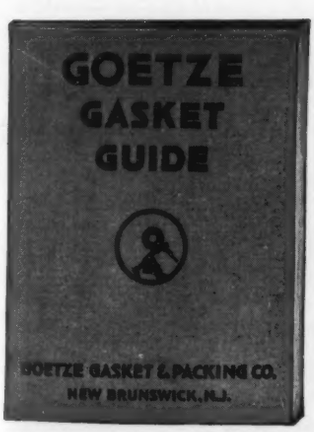

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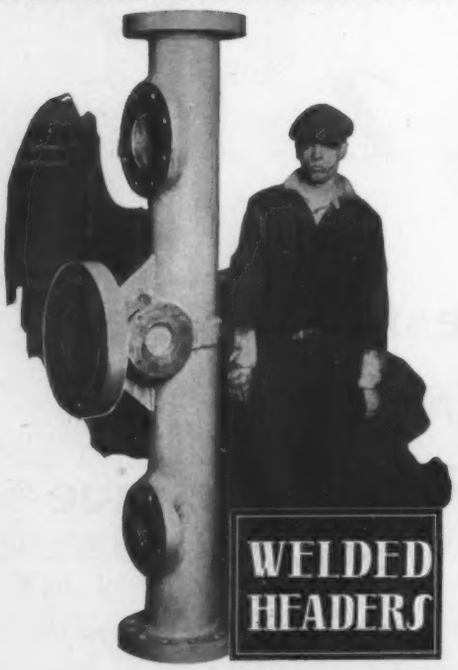

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Moody Sells Plant

Houston—Together with other properties, the Superior Oil Corporation has purchased from the Moody Corporation a 12,000-gallons natural gasoline plant 11 miles northwest of Cisco, Texas, operating under the name of the Adams Gasoline Company, a subsidiary of the Moody Corporation.

During the present year additions and repairs were completed at the Cisco plant, increasing the capacity from 2000 to 12,000 gallons. The plant is not operating at full capacity, however, at present.

Fighting Corrosion

McCamey, Texas — Phillips Petroleum Company is now working on its gasoline plant in the Crane-Upton Counties pool, and expects to have it in operation about the middle of December. Daily output of the plant will be approximately 75,000 gallons.

The plant constructed will incorporate equipment specially designed and made from special alloys to withstand hydrogen sulphide gas corrosion, and after the plant begins operating, data will be kept in regard to the special equipment to check up on its effectiveness. Special means of ventilation will also be made use of in the new plant.

Craig, Colo.—In January The Texas Company will start work on the doubling of the capacity of its local refinery, another unit to duplicate the one now in use to be installed. Several steel storage tanks for crude and refined oil will be installed.

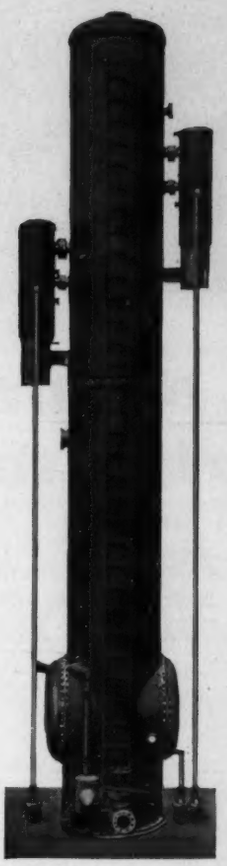
Humphreys Corporation, with headquarters at Houston, is reported to be planning to erect a two million cubic foot capacity natural gasoline plant on its producing properties in Brown County, Texas.

Analytical apparatus, for analyzing natural gas and gasoline into their individual hydrocarbons developed by Dr. Walter J. Podbielniak, has been installed in the research laboratory of J. A. Campbell, Long Beach, California, to be used for the fractionating of gasoline, gas, and vapors. This addition to the "Oil Froth" laboratory and research equipment will put the organization in better position to check on existing apparatus, and to analyze more efficiently the raw gases for which its plants will be designed for the extraction of natural gasoline. The Podbielniak analytical apparatus is operated by W. R. Davis, Jr., under the supervision of H. N. Wade, research engineer for J. A. Campbell.

Dr. Podbielniak advised that similar apparatus has been, or is being installed by Southwestern Engineering Corporation. The Texas Company, O. C. Field Gasoline Company, Union Oil Company, in California, and by Skelly Oil Company, Chestnut and Smith Corporation and Phillips Petroleum Company, and others.

In Step With Natural Gasoline Progress

Fluctuating markets mean constantly changing refinery specifications. And changing specifications demand highly adaptable equipment, of extreme flexibility—equipment that will effect maximum absorption—that will denude the oil of all light natural gasoline fractions—equipment that will give the sharpest, cleanest cuts.



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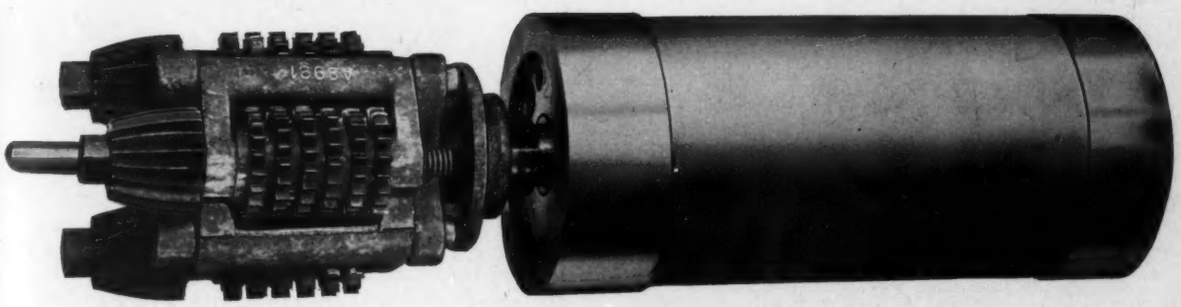

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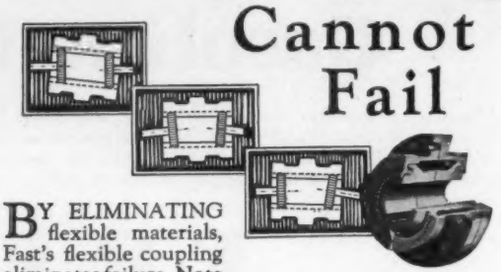

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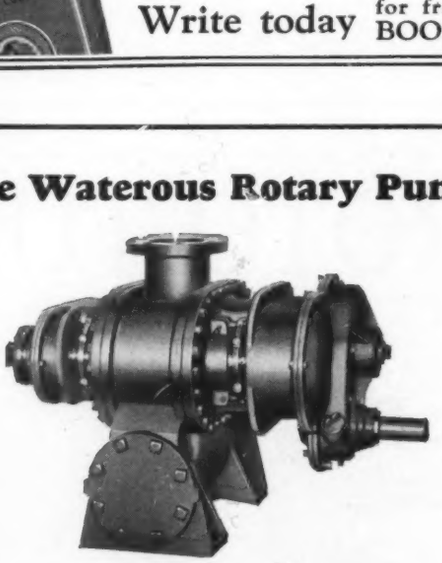

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ABSTRACTS OF TECHNICAL LITERATURE

Of Particular Interest to the Plant Operator

Improvements in Pressure Cracking Treatment of Oils. (*Petroleum Times, August* 25, 1928, *p.* 329. *Libr. Bull., U. O. P. Co., Vol* 3, *No.* 37). A British patent granted to the Anglo-Persian Oil Company, Ltd. (Beale, Coxon and Dunstan) covers an invention applying especially to a liquid-phase cracking process. The invention consists essentially in surging the oil back and forth through the zigzag of tubes in which it is treated by means of a reciprocating pump, the cylinder of which is connected by tubes to the inlet and outlet of the coil. The oil is kept in turbulent motion, its velocity is such that skin temperature is low, comparatively little carbon forms, and the most of that is held in suspension, passing out with the oil. With this system it is not necessary to use small tubes, and for cracking asphaltic residues it is an advantage to use large ones. The process is once-through while the surge is very rapid the feed flow of the oil is slow. Heating may be more or less rapid to about 280° C. (716° F.) and is then continued gradually to a cracking temperature of 450° C. (842° F.) as a maximum. The temperature is then allowed to drop, as decomposition becomes active and the vapors generated increase the pressure. This procedure, it is claimed, yields a maximum of cracked products for the working pressure, with a minimum of vaporization. The oil may be cooled 50° C. (90° F.) in the tubes and then flashed into the dephlegmator by reducing the pressure, or may be passed to the cooler for retreating or distilling. Surging may be continued in the cooler tubes; and two or more pumps may be used in the heating part of the system, if the requirements of heat in-put and turbulance call for them.

A Persian gas oil treated in an experimental plant with a capacity of 100 gal. per day yielded 23-25 per cent. of motor gasoline boiling below 200° C. (302° F.) with less than 0.01 per cent. of coke; and a Persian 65-per cent. residue yielded 15 per cent. of motor gasoline of the same volatility, with less than 0.1 per cent. of coke.

The Cracking of Shale Oil. Gault and Stemart. (*Chem. et ind.*, 17, 402-03 (1927). *Chem. Abs., June* 10, 1927, *p.* 1882.) Results obtained in an investigation of the cracking of crude oil obtained from Autun shales, given in tabular form, lead to the following conclusions: (1) Maximum yield of gasoline fraction is obtained at about 600°, with a good yield of olefin hydrocarbons; (2) maximum yield of olefin hydrocarbons is obtained at about 650°, with a good yield of gasoline; (3) good yields of both gasoline and olefin hydrocarbons were obtained at about 625°; (4) gas production increases with the temperature, without reaching a maximum (up to 900°), but the curve is almost horizontal at 650-700°. Gas oil from Autun shale gave similar results but at approximately 50° higher temperatures. Absorption of sulfuric acid of the olefin hydrocarbons formed was always difficult, the gases being polymerized rather than absorbed. In order to absorb the propylene, the gases had to be cooled, under which condition absorption in 95 per cent. sulfuric acid was quantitative by passing the gas twice through the acid; but the yield of isopropyl alcohol was always much lower than the propylene content of gases.

Improved Manufacture of Cracked-Benzine from Brown-Coal Tar and Shale oils. Karsten - Salmony. (*Chem.-Ztg,* 209-10, 232-3 (1928) *C. A., Vol.* 22, *No.* 11, *p.* 2050). The Blumner cracking process produces about 70 per cent. refined benzine from paraffin-base oil, 50-60 per cent. from asphaltic oil and 35-50 per cent. from brown-coal tar. The benzine contains approximately 15-20 per cent. aromatics. Light gasoline is recovered by activated charcoal from the approximately 10 per cent. uncondensable gas evolved in cracking.

Treatment

Polymerization and Other Chemical Reactions in the Sulfuric Acid Refining of Cracked Distillates. Morrell, (*Ind. and Eng. Chem., Vol.* 19, *No.* 7, *p.* 794. *Libr. Bull., U. O. P. Co., Vol.* 2, *No.* 29, *pps.* 233-35). *Known facts as to the polymerization of unsaturated hydrocarbons.*

Pentane is changed by fuller's earth to dipentene, cyclopentadiene to dicyclopentadiene. Pinene or turpentine yields dipiene, dipentene, and terpinene. Isobutylene is polymerized to di-isobutylene. Octene treated with 96 per cent. sulfuric acid was very largely converted to di- and higher polymers. Pinene and limone were converted to the di- and tripolymers by 85 per cent. sulfuric acid.

Losses by polymerization in treating pressure distillates with 0.78 *to* 50 *per cent. of* 1.84 *gravity sulfuric acid.*

Less than two per cent. based upon the gasoline, up to 10 pounds of acid per barrel (1.55 per cent.); and less than three per cent. up to 20 lbs. of acid per bbl. (3.10 per cent.), for light California crudes and for a heavy California crude. Tonkawa crude lost slightly over one per cent. by treatment with five-six pound of acid per barrel (0.78 per cent.) Cushing crude even gave slightly more gasoline after treating, possibly because light fractions were polymerized and held, which fractions without treating would have escaped.

Solubility of reaction products in the acid sludge.

For Mid-Continent cracked distillates, the sum of the solution losses of the gasoline and gas-oil fractions were about equal to the solution loss of the pressure distillate. For California cracked distillates, this sum was greater than the solution loss of the pressure distillate. This may be explained by the precipitation of asphaltic material in the California gas oil.

Difference in effect of sulfuric acid upon gasoline and its distillate and residue.

Gasolines from California gas oil, Cushing gas oil, and Tonkawa topped crude showed only about one per cent. loss when distilled to 210° C. (410° F.) after treating. But the residue from the treated and distilled gasoline had a much greater range of boiling than the residue from the untreated. When the gasolines were distilled first and distillate and residue were treated separately, both residue and distillate were found to have widely extended their boiling range. For the separately treated distillate, this must have been due to some other influence than polymerization.

Effect of sulfuric acid on the F. B. P. of cracked gasoline.

Sulfuric-acid treatment produces little change in the boiling-point curve of California cracked gasoline. The Mid-Continent cracked gasoline distillation curves for various amounts of acid used lay considerably higher than that for the untreated gasoline. The curves are raised somewhat by the use of larger proportions of acid. But the most pronounced effect upon the curves of end-point gasolines is the raising of the end point itself. Neutral esters are probably formed with the comparatively small amounts of acids used and it is believed that the end point is raised by these esters being decomposed in distillation, as well as by polymerization.

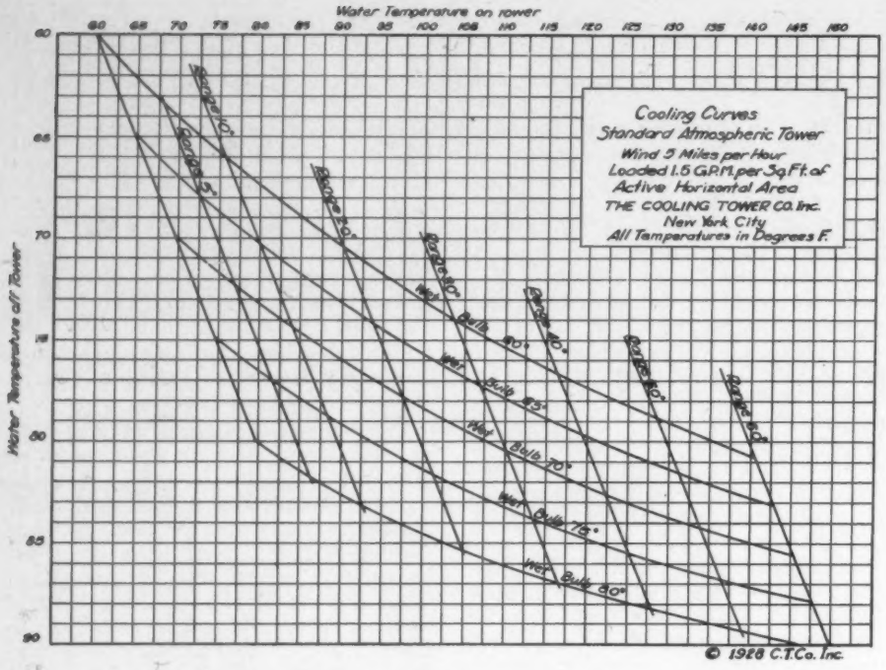
Effect of sulfuric acid treatment on the composition of cracked distillates.

Olefins are most acted on by sulfuric acid treatment; but some naphthenes, aromatics, and paraffins are known to be acted on, at least under some conditions. The table shows that while the percentage of unsaturates is lowered by acid treatment, the effect upon anti-knock properties cannot be important unless large amounts of acid are used, as for desulfurizing.

Effect of H_2SO_4 Treatment on Composition of Cracked Distillates.

Type of Cracked Gasoline—	Unsaturated %	Aromatic %	Naphthene %	Paraffin %
From California pressure distillate; Untreated	25.8	10.8	19.8	43.6
Treated (8 pounds acid per barrel)	23.2	11.5	19.6	45.3
From Midcontinent (Cushing) pressure distillate Untreated	17.8	22.5	9.2	50.5
Treated (5 pounds acid per barrel)	14.3	21.6	9.6	54.5

The "White Oil" Reaction. Loe. (*Chem. and Ind., July* 22, 1927, *p.* 667). It is often



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assumed that in the process of converting a mineral oil to a bloomless white oil by continued treatment with sulfuric acid, what is taking place is the removal of the unsaturated, that is, the more easily attacked hydrocarbons, leaving the saturated, assumed to be the paraffin compounds. There are reasons for believing that, beyond a certain point in the treatment, the acid acts to break up the existing molecules and form new ones, more likely *iso*-paraffins. The usual acid treatment of lubricating oils removes resinous substances, asphaltic bodies, traces of nitrogenous compounds, cracked hydrocarbons, and occasionally sulphur compounds and natural petroleum acids. The soda wash neutralizes all acids. Most lubricating oils not cracked in distilling are probably made up of definite series of hydrocarbons, the series varying with the source of the oil. A cracked oil like shale oil cannot be acid-treated to a bloomless white oil; it will all be treated away except a small residue of paraffin. A Russian naphthenic oil, if treated carefully with acid of proper strength, will give a white oil of definite end point. From the yield and the specific gravity of the product, one might easily calculate the gravity of the removed oil if the action of the acid had been merely a separation. As one of many examples, a Russion oil of gravity 0.910 will yield 50 per cent. of white oil of gravity 0.885. The removed oil should have a gravity of 0.935. But though a Russian oil of gravity 0.890 has been separated without decomposition into as many as 16 fractions, none of these has any such high gravity as 0.935. Each fraction will yield practically the same amount of white oil, require the same quantity of acid, and show a characteristic drop in gravity. Other oils similarly give indication of *type* in all their fractions. It is possible to obtain a curve or equation such that, taking a partially acid-treated oil and carrying it a few stages farther and then referring the figures to the curve, the gravity of the original oil and that of the final product can be calculated. In many cases the original crude can be identified. It is the author's conjecture that the lower hydrocarbons in the oil are chain compounds with one methylene ring; the higher have more rings and perhaps side chains; and that these rings are broken up and the residues rebuilt into isoparaffin molecules. The positions originally occupied by the rings are probably the points attacked in oxidation of the white oil.

Filtration

Alumina Gel as a Desulphurizing Agent in Petroleum Refining. Chowdhury and Bagchi. (*J. Indian Chem. Soc.* 1928, 5, 111-125. *B. C. A.-B, May* 11, 1928, *p.* 324). Alumina gel (water content 6%), activated under optimum conditions by the ignition of aluminum hydroxide at 350-400°, absorbs a large number of sulphur compounds from their solutions in petroleum, and more especially those in which the sulphur is contained in an oxidized form. Thus a preliminary oxidation of solutions of bivalent sulphur compounds by the passage of air in the presence of alumina

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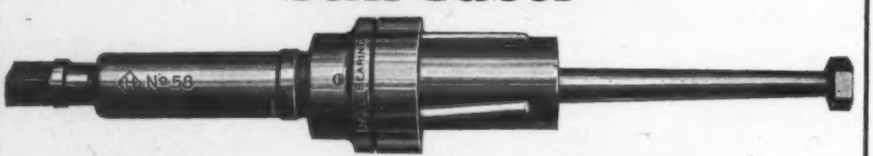
Heavy Duty Expanders for Still Tubes



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gel leads to more complete absorption (cf. G. P. 405, 850; B., 1925, 179). Adsorption is also increased by the use of large amounts of very finely-divided alumina gel, but these modifications involve a loss of petroleum and difficulties of filtration. Admixture of activated carbon with the gel yields an adsorbent which is more efficient than either of its components. More pronounced results are obtained by the use of a mixture of alumina and silica gels, prepared by the precipitation of alumina on an inert surface such as powdered glass or pumice. Alumina may be reactivated by treatment with superheated steam and air. The application of Freundlich's equation in the examples in which the pure gel is used show that the action is one of true adsorption.

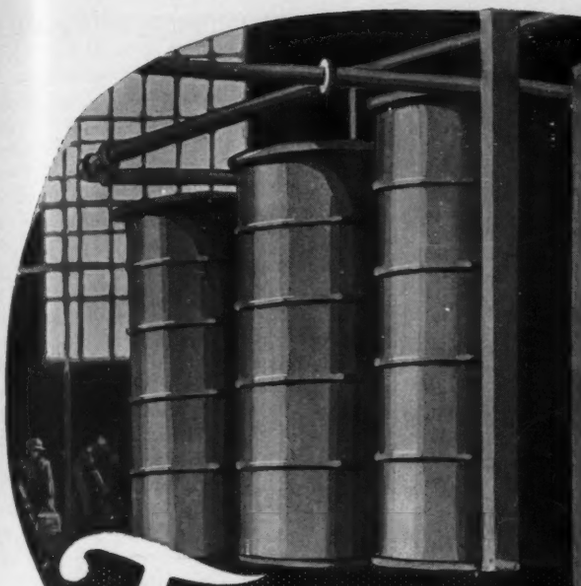
Of Particular Interest to The Refinery and Chemical Engineer

The Practical Problems of Corrosion. Evans and Haines. (J. S. C. I., Sept. 9, 1927, p. 363T. Libr. Bull., U. O. P. Co., Vol. 2, No. 38, pps. 330-31). This paper is a study of the corrosion phenomena taking place at discontinuities in protective coverings, particularly paint coverings.

The fundamental fact in the corrosion of metals immersed in a liquid is the presence of oxygen upon the metal. If this can be screened away corrosion will not occur. If a rust coating completely covers an exposed spot, corrosion will be "self-stifled"; but if the rust covering an area of some size is removed at one point, "differential aeration" may cause corrosion to continue, electrollytically, on the part still protected by rust. Cracks in a paint, for instance of the bituminous class, produced by bending the metal to which it is applied, do not always open the way for corrosion: there is sometimes a closely adherent film left unruptured. Acid waters produce looser, less adherent rust than alkaline; but alkali in the water will sometimes attack and soften the paint vehicle and even act upon the pigment. Aluminum and bituminous paints to a less extent. paints show the self-stifling effect well, When rust collects under a coating of paint, it is probably due to pinholes and by its greater bulk it is likely to push the paint away from the metal; but chloride ions are capable of making their way through the film of oil itself. In salt water, therefore, ferrous chloride is at the anodic area and sodium hydroxide at the cathodic; when these meet ferrous hydroxide forms, which is soon oxidized to ferric hydroxide; and the rust collects outside the paint coat.

Bronze paints afford less protection to steel than aluminum; as if the bronze acted cathodically to the steel, the aluminum anodically.

Tests as to the effects of acid fumes upon paint coatings showed that the products of corrosion were very hygroscopic, especially when hydrochloric acid fumes were used; that the acid fumes penetrated at the edges of the metal test plates, where protection was not complete;



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that corrosion spread laterally below the coating, as has been noted in industrial plants, rather than downward; and especially, that bituminous paints, with all their mechanical strength, do not give as good protection as compositions containing coal tars and lime. The bituminous paint-skin would be completely peeled off from the corroded surface below. From the tests as to protection against salt water corrosion, no coating tried was completely effective; the best one was one which had given good results in practice.

No preparation of the metal surface before using a protective paint is so important as the removal of water; but in a highly acid atmosphere the coating is certain to be undermined within a few months if there are cracks or pinholes in it.

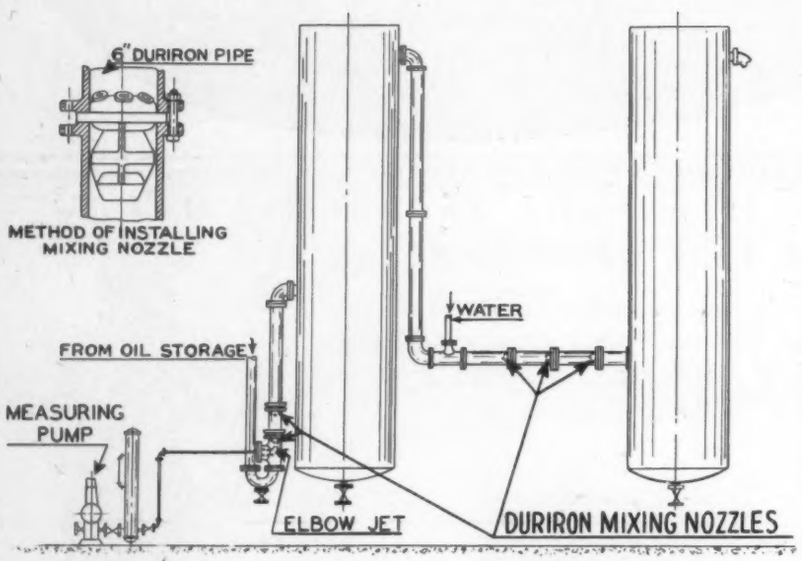
If a paint covering must be put on iron or steel without removal of scale, the entrapping of air should be avoided by adjusting the surface tension and viscosity of the paint vehicle to enter crevices as perfectly as possible. A complete covering of scale formed by heating the metal to redness was even beneficial, so long as it remained unbroken; but the break formed a danger point. Scaly material is best protected by a paint containing a flaky or scaly pigment.

No protective covering is good for all purposes. Each case must be studied by itself.

Theory of the Absorption Tower. Cantelo. (*Chem. and Met. Eng.*, 33, 680 (1926). *B. C. A.-B, Jan.* 7, 1927, *p.* 1). In a countercurrent gas-scrubbing tower where the velocities of the gas and liquid are uniform, it is shown that the partial pressure of the solute in the liquid at a point X is given by $p=1.314\ Tm/M$, where T is the average temperature in the tower, m the concentration of the solute in the gas in lb. /cu. ft., and M the molecular weight of the solute. Further, $dx/dt=M.U/1.314\ rAT'$ times $(1-p'w-p')/(M/1.314T(1-pw)-m)$, where U is the volume of gas in cu. ft/hr., r is the fraction of free space per unit vol., A the cross section of the tower, T' the absolute temperature at the top, p' the partial pressure of the solute at the top, $p'w$ the vapor pressure of the liquid at T. These equations are further developed in order to determine the rate of dissolution dm/dt or the dissolution coefficient for the following special cases: (1) in which the solute obeys Henry's law: The amount of a gas dissolved by a liquid is proportional to the pressure to which the gas is subjected; (2) in which the solute obeys Raoult's law, as in the scrubbing of coal gas for benzol: The ratio of the observed lowering of the vapor pressure of a solvent by a non-volatile solute to the vapor pressure of the pure solvent is equal to the ratio of the number of mols of the solute to the total number of mols in the solution; or $\frac{p_1-p_2}{p_1} = \frac{n}{n+n}$;

(3)in which a chemical reaction takes place yielding a compound of negligible vapor pressure, or the solute is very soluble in the liquid.

Low Cost of Treating



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Of Particular Interest to The Chemist Testing And Analysis

Pendulum Viscosimeter. Albrecht and Wolff. (*V. D. I. Zeit., Sept.* 16, 1927, *p.* 1299. *Mech Eng. Dec.* 1927, *p.* 1384). Describes Spindler and Hoyer instrument, in successful use by Deutsche Reichsbahn Gesellschaft, which measures viscosity by means of a pendulum made to oscillate in the medium tested; viscosity is indicated by the time it takes to dampen oscillations.

Conditions of Flow into the Vertical Capillary Tube of the Saybolt Thermo-Viscometer. Herschel. (*Ind. and Eng. Chem., Vol.* 19, *No.* 7, *pps.* 837-40). In previous work on the flow into vertical capillary tubes, it was assumed by the author that the drainage error and "end effects" were negligible and differences between experimental and calculated times of flow were ascribed to inaccuracy in measuring the diameter of the capillary. In the work described in this article, it was found that these sources of error caused a reduction of about 9 per cent. in the time of flow, as compared with the values calculated on the assumption that such errors were negligible.

Comparison of Gasolines by Analytical and Test Methods. Stevens and Marley. (*Ind. and Eng. Chem., Vol.* 19, *No.* 2, *pps.* 228-31). Eighteen gasolines composed entirely of petroleum were analyzed for their content of paraffins, naphthenes, aromatics and unsaturated hydrocarbons according to the method recently described by Egloff

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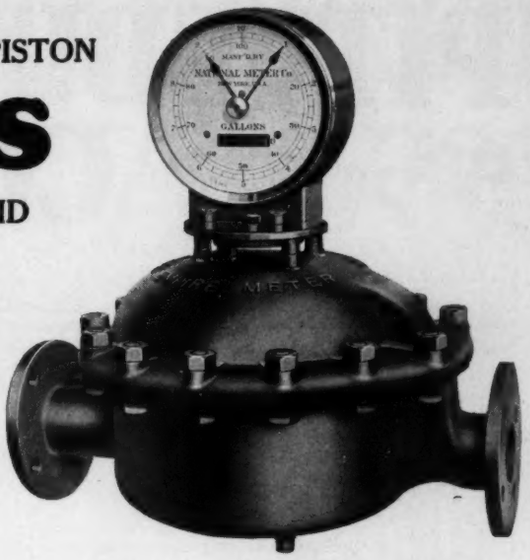

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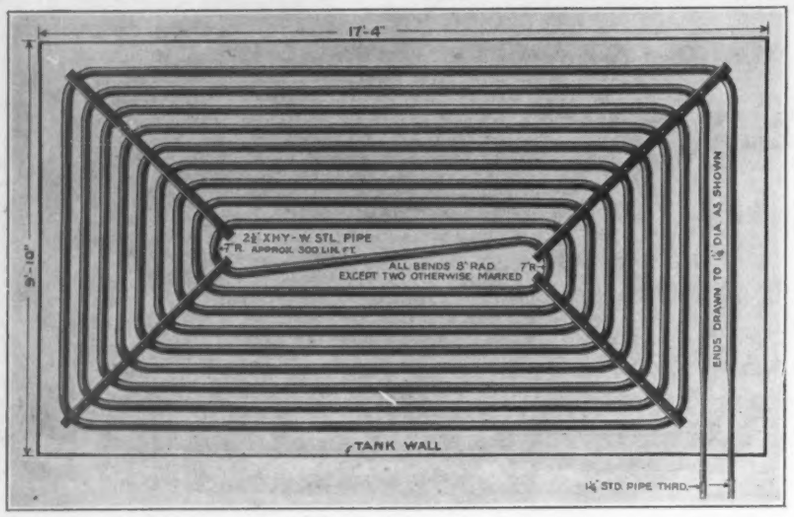

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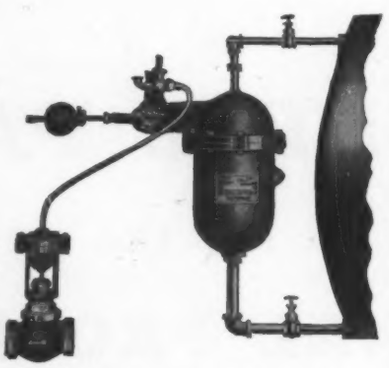

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and Morrell. The same gasolines were then tested for detonating tendency by engine test, using a direct reading detonation indicator. Comparison of the benzene equivalents calculated from analysis with those determined by engine tests shows that the agreement is moderately fair for about half the fuels studied but that rather wide discrepancies are found in the other cases. *It is recommended that fuels be studied for detonating tendency, only by direct engine test.*

Use of Chromate Solutions as Comparison Standards for the Determination of "Gasoline Color Values." Jorgensen. (*Cereal Chemistry*, 4, 468-9 (1927), *C. A., Vol. 22, No. 4, p.* 553). Jorgensen has shown (C. A. 21, 3848) that solutions of CrO_4—in the presence of suitable buffers can be used as indicators for H^+. Experiments with Sorensen's "Phosphate buffer mixtures," and $K_2Cr_2O_7$ are described to illustrate this fact. The most marked color change appears at pH 6-7. It is proposed now to use K_2CrO_4 solution mixed with Sorensen's "0.5 Na_2HPO_4 and 9.5 $NaHPO_4$" solutions for determining color of gasoline. In this solution the chromate takes a color which seems very similar to that of the gasoline extracts of flour. By varying the buffer mixtures in which the chromate is dissolved, it is possible to prepare solutions of various red-yellow and lemon-color tints.

Determination of Unsaturateds in Lubricating Oils. Bacon. (*Ind. and Eng. Chem., September,* 1928, *p.* 970). A method was devised by Francis (Ind. and Eng. Chem., 1926, p. 821) of determining unsaturateds in oils by adding a slight excess of standard potassium bromide-bromate solution, acidifying, using potassium iodide as the indicator, and titrating the iodine released with thiosulfate. The process has now been modified to be more easily used for dark oils, such as lubricating oils or untreated cracked gasoline. The oil sample is diluted with 10 c.c. of c. p. benzene or gasoline of known content of unsaturateds; a slight excess of bromide-bromate is added, with potassium iodide; the excess should be such as to leave the water layer colored slightly with bromine; the iodine is titrated with thiosulfate, running a little past the end point; and the excess is titrated with standard iodine. The flask must be shaken very thoroughly to get all the iodine out of the oil. The bromine number, that is, the bromine absorbed per 100 grams of sample,

$$B = \frac{80}{VD}(TN + T_2N_2 - T_1N_1)$$

in which V and D are the volume and density of the sample and the T's and N's refer to the titration and normality of the bromide bromate, thiosulfate, and iodine.

In order to calculate the percentage of unsaturation the molecular weight was determined by Menzies' method of noting the change in vapor pressure when the substance, the molecular weight of which was sought, was added to a boiling solvent. The product of bromine number by molecular weight divided by 160 is the percentage of unsaturateds.

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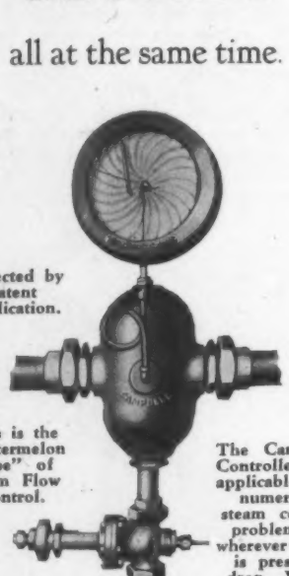

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Fraction of the Light-Oil Residue from Light Petroleum Gas Tar. Pyhala. (*Erdol u. Teer* 4, 58-9 (1928); *C. A. Vol.* 22, *No.* 8, *p.* 1465). With Baku oil, naphthalene crystallizes out from the corresponding fractions when the residue is distilled with partial decomposition, but not when distilled in the usual manner with superheated steam. Under still more severe temperature conditions, however, the yield of naphthalene is reduced, and yet no anthracene and only negligible proportions of benzene and toluene are obtained.

Non-acidic Oxidation Products of Paraffin Wax. Francis and Gauntlett. (*J. C. S.*, 130, 2377 (1926). *Libr. Bull., U. O. P. Co., Vol.* 2, *No.* 1, *p.* 2). The non-acidic oxidation products obtained from paraffin wax consists of secondary alcohols and ketones with a carbon chain of 26-29 atoms, and with the ketone oxygen situated on the third or fourth carbon atom; and of dihydric alcohols, hydroxyketones, and diketones. The quantity of non-acidic products formed diminishes as the oxidation proceeds, owing to the formation of acidic substances.

Ethyl Alcohol Makes Good Showing in French Fuel Tests. (*Automotive Industries. Vol.* 57, *No.* 9, *Aug.* 27, 1927, *pp.* 302-03). Starting of engine more difficult than with gasoline, but in other respects results were up to standard; entrants divided into classes according to fuels used.

Petroleum Lubricating Oils. Scott. (*Petroleum World.* 24, 378, 380 (1927). *C. A., Vol.* 22, *No.* 1, *p.* 160.) A general discussion of lubricating properties, of which oiliness is the essential factor. Microscopic illustrations of oil films are given to show the changes on use.

Characteristics and Applications of Lubricating Oils. Taylor. (*Chemistry and Industry,* 47, 2-7 (1928). A lecture giving a general description of the physical, chemical and mechanical properties of lubricating oils.

Cylinder Lubrication of Diesel Engines. Rosen. (*Pac. Mar. Rev., Vol.* 24, *No.* 12, *Dec.* 1927, *pp.* 568-569). Kinds of oil used, methods of application and distribution and combustion processes.

New Development in Air-Intake Protection. (*Oil-Engine Power, Vol.* 5, *No.* 11, *Nov.* 1927, *p.* 762). Well-known type of centrifugal air cleaner adapted to Diesel requirements.

NATURAL GAS INDUSTRY

The Active Carbon of the Urbain Process. (*Petr. Times. Apr.* 16, 1927, *p.* 708). The Urbain adsorption carbon is activated as made. A Dutch peat, low in ash, constitutes the raw material. The peat is mixed cold with phosphoric acid in the proportion of 6 or 7 kilos of peat to 2 or 3 kilos of acid, depending upon the amount of water in the peat; this varies from 15 to 25 per cent. The cellulose of the peat is hydrolyzed by the acid forming a jelly which is heated at 500 degrees C. (932 degrees F.) till the water is expelled. The material is then transferred to retorts and the heating continued at 1000 degrees C. (1932 degrees F.), with sufficient air admitted to prevent the phosphoric acid from being reduced. The latter as phosphorus pentoxide volatilizes and passes out of the retort, to be recovered as a very pure phosphoric acid. The carbon is freed of the last of the acid by means of sodium carbonate and this acid is also recovered. The carbon is dried at 500 degrees C. and sieved and sorted.

The Urbain active carbon is principally used for:

(1) the recovery of light liquid hydrocarbons from the natural gases from certain wells in Poland and Roumania.

(2) the recovery of volatile solvents used in various chemical industries, such as the manufacture of artificial silk and perfumes.

(3) the manufacture of gas masks.

(4) decolorizing purposes in the preparation of pharmaceutical substances.

The best of the three grades in which the carbon is made is used for adsorption of hydrocarbons from gases or of solvents. The second grade is less active, and the third called "Phospho-Karbon," is still less so.

The vertical type of adsorption chamber used for the removal of hydrocarbons from natural gas is a round tower with a central gas-admission pipe. Pipes are provided for cooling with water while adsorption is in progress or for superheated steam when the adsorbed material, after about 6 hours' run, is to be driven out. The carbon gradually loses its effectiveness and must be renewed. Coal gases containing a tar mist must be filtered before passing to the main adsorption chamber.

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Supplement to Arc Welding—New Age in Iron and Steel

The Lincoln Electric Company has recently published a supplement to its 160-page text book, "Arc Welding—The New Age in Iron and Steel." This 32-page book is entitled "How to Begin the Application of Arc Welding in Production Manufacturing."

The bulk of the text is devoted to the redsign of machinery and the principles involved are set forth in such a manner that no designer can fail to find the text helpful.

In developing the theory of arc welded design many lines drawings have been used which show clearly how standard steel shapes are utilized to build up structures which formerly would be cast.

Along with these theoretical designs, however, are shown photographs of similar designs which are in actual use.

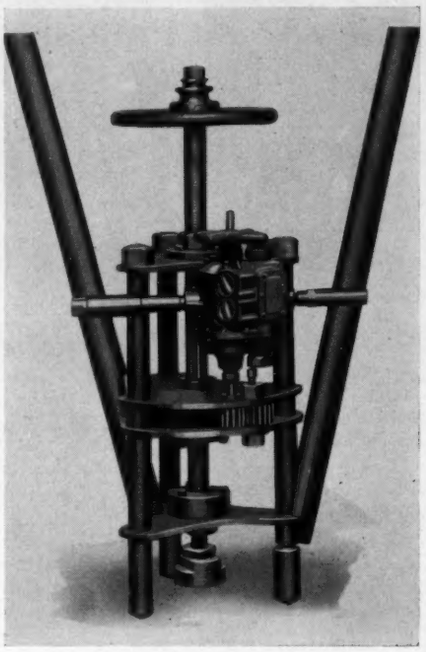
The supplement is a convincing proof of the rapid strides which are being made in the substitution of welded steel for cast iron as many of the forecasts made in the original text are seen as proven facts in the supplement.

The Lincoln Electric Company plans to distribute the supplement without charge to all present owners of the parent text book. Individual copies of the supplement can be obtained at a small charge from the company.

Bristol Catalog

The Bristol Company, Waterbury, Connecticut, manufacturers of Bristol's Recording Instruments, has just issued a new catalog, No. 1900, featuring Bristol's Long Distance Electric Transmitting and Recording System. As explained in the catalog, the system consists of two instruments: a transmitter and a receiver, electrically connected, which permits taking readings of pressure, vacuum, temperature, liquid level, motion, and so forth at one point, and simultaneously indicating or recording these readings at another point from a few feet up to several miles away. In this way the information recorded at the various places in industrial plants or systems may be transmitted to a central point of control.

The catalog comprises 24 pages, and includes numerous illustrations of recording and indicating instruments and gauges; descriptions and illustrations of installations; charts and tables; and other information. It is a very attractive, neat and comprehensible booklet. Copies may be had from the company, on request.



Young Valve Tool.

Young Valve Tool

HILLS-McCANNA COMPANY

Hills-McCanna Company, 2349 Nelson Street, Chicago, manufacturers of the Young Tank Car Bottom Outlet Valve, announces a new tool which was devised to make the installation of the Young valve a simple process. Using this tool the valve can be installed in any tank car equipped with an outlet leg.

The tool is placed inside the tank car, and over the outlet two of the three legs of the tool are placed parallel to one side of the tank and the third leg, which is adjustable, is placed on a line with the outer side.

This permits the tool to be leveled to the curve of the tank and allows the working side to face the tank end, giving room to operate air motor and adjust chuck.

After the tool has been centered, one of the long jack-rods is placed on the bottom plate of tool, between the two solid legs and up to the rivets of tank dome. The second jack rod fits against the adjustable leg and up to dome rivets. These are tightened so that the tool is solid.

Then the chamber for packing is drilled out and threaded. The tool is then removed and the Young valve installed. Into the drilled chamber is first placed a lower metal packing ring and non-metallic packing and above this an upper packing ring which is cut with a shoulder. Above this the cage of the valve is screwed down tight, and a dog point screw is set. Next the valve is closed tightly and the stem measured. It is cut off three inches above the brackets. The ends are squared. One end of rod is swedged in the coupling and the other end squared and tapered to receive the handwheel. The rod above the wheel is drilled for cotter pin.

Much interest has been shown toward the Young valve since it prevents leakage in transit and overcomes difficulties encountered with the metal to metal closure. The simplicity of design and absence of metal to metal surfaces makes the valve of interest to shippers of liquids hard to hold by usual means.

The tool above and all necessary adjuncts can be purchased or rented at nominal cost to user. A bulletin has been issued by the manufacturer and will be mailed to anyone interested.

Effective November 1, the main offices of the Walter E. Lummus Company will be at 148 State street, Boston. The telephone number there is Richmond 4842. The New York office will be at 30 Church street, telephone Cortlandt 1650.

C. & G. Cooper Takes Over Hope Engineering Plant

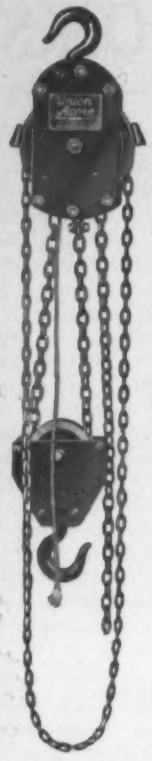
The C. & G. Cooper Company has purchased the manufacturing end of the Hope Engineering Company, including the Hope manufacturing plant, plant site and engine designs.

Starting with October 1, the Hope plant is being operated as a division of the Cooper organization. For a time, at least, the Hope organization, including their branch offices will continue to sell and service Hope engines and other Hope equipment just as they have done in the past. This, however, is purely a sales connection and represents the only connection between the two organizations, which will continue to maintain as always their separate and unallied identities.

The Hope factory, located in Mt. Vernon, Ohio, only a few blocks from the Cooper plant, will permit of a much needed further expansion in Cooper manufacturing facilities. In recent years the rapid growth of the Cooper business has made it necessary to go outside of Mt. Vernon for manufacturing capacity. The purchase of the Hope plant will allow more of this work to be done in Cooper plants under closer supervision.

The Hope line of vertical gas engines and compressors will also fill out the Cooper line which up to now has consisted of the slow speed horizontal types, chiefly in the larger sizes.

The sale of the manufacturing end



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A Mechanical Device Sealing Any Rotating Shaft in the Stuffing Box and Revolving *with* it.

Applications	*Eliminates*
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Sulphur Dioxide	Leaks
Carbon Dioxide	Expense
Gases	Trouble
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Water	Hot Boxes
Brine	Shut Downs
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of the business will permit the Hope Engineering Company to devote more of its efforts to the pipe line and construction end of its business, which in recent years has grown to constitute its major interest.

New Wyatt Plant at Houston

The Wyatt Metal & Boiler Works has started construction at Houston of a manufacturing plant which will have an initial floor space of 75,000 square feet. It will be specially equipped with machinery for building the heavy plate work in both riveted and welded construction now required in modern refining practice.

Additional special equipment will include 36-foot bending rolls, plate planer and G. E. automatic arc welding machines. These machines will build welded steel pipe, cylinders and tanks in 36-foot lengths for a single plate and having a joint of 100 per cent. efficiency or equal strength to the solid plates.

The company will also install automatic electric welding equipment to manufacture underground storage tanks for filling stations entirely by the automatic process.

The Wyatt Metal & Boiler Works already has a plant at Dallas, comprising 100,000 square feet of floor space. The Dallas and Houston shops together, with a combined floor space of 175,000 square feet, will have capacity for fabricating 25,000 tons of plates and sheets.

The Houston plant will be located on the M. K. & T. and Southern Pacific tracks at Washington Avenue.

The company builds tanks of every character from steel plate, including pressure and storage tanks; refinery equipment; smoke stacks; breechings; air ducts; natural gasoline plants; and bulk storage tanks. In addition, the company builds road culverts, road strips, and all kinds of galvanized, plain and corrugated metal work.

Distillation apparatus, developed by Dr. Walter J. Podbielniak, is being installed by the inventor in the research laboratory of J. A. Campbell, at Long Beach, California, to be used for the fractionating of gasoline, gas and vapor samples.

With this apparatus, the Campbell organization will be in better position than ever to check up on existing apparatus, thereby being guided in designing more perfect equipment for use in gasoline plant construction.

The Podbielniak apparatus will be operated by W. R. Davis, Jr., under the direct supervision of H. N. Wade, research engineer for J. A. Campbell.

The Homokle Oil Company, Allen, Oklahoma, has awarded contract for the construction of a new oil refinery to the Graver Corporation, East Chicago, Indiana. Estimated cost of the plant is $125,000.

The several codes on natural gasoline will involve so much printing that H. A. Trower, president of the Natural Gasoline Association of America, has named a committee on publication. A. V. Borque, secretary of the association, is chairman and the other members are S. B. Crooks, Empire Gasoline Company; George P. Bunn, Phillips Petroleum Company, and A. F. Woods, Chestnut & Smith Corporation.

The Texas Company of Houston and the Lovell Gasoline Corporation of Los Angeles are new members of the Natural Gasoline Association of America.

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